AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3
USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166
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DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-1

USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY

by

Francine G. Buckley, Cheryl A. McCaffrey
Manomet Bird Observatory
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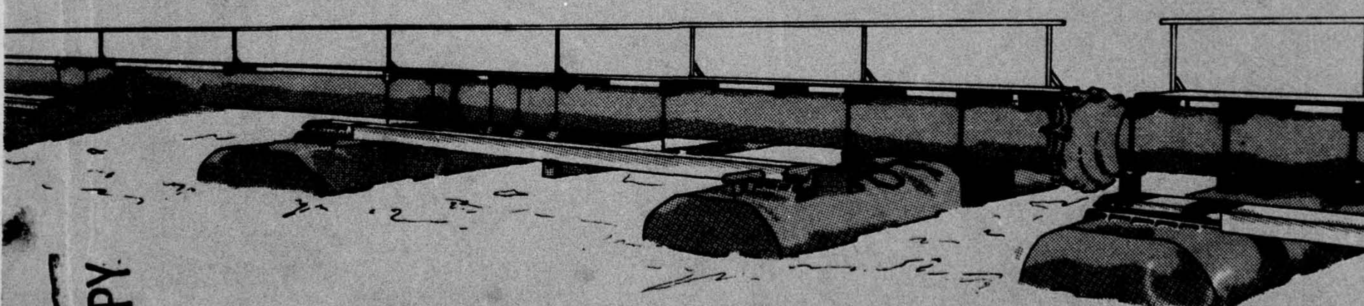
June 1978
Final Report



Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under Contract No. DACW39-76-C-0166
(DMRP Work Unit No. 4F01D)

Monitored by Environmental Laboratory
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1. The technical report transmitted herewith represents the results of Work Unit 4F01D, regarding vegetation succession and wildlife use of dredged material islands in New Jersey. This work unit was conducted as part of Task 4F (Island Habitat Development) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 4F was part of the Habitat Development Project of the DMRP and had as its objective the investigation, evaluation, and testing of methodologies for habitat creation and management on dredged material islands.

2. Island habitat development was studied by the DMRP throughout the United States through an evaluation of vegetation succession and animal use of existing dredged material islands. The most significant wildlife aspect of these islands is their use by colonial nesting sea and wading birds (such as gulls, terns, egrets, herons, ibises, and pelicans). This wildlife resource, although generally inadvertently created, presents a significant opportunity for habitat management and development that is consonant with continued dredged material disposal.

3. In the study reported herein, dredged material islands along the Intracoastal Waterway of New Jersey were surveyed and 20 were examined in detail. It was found that waterbird habitat is quite scarce in New Jersey and that 75 percent of arboreal and 20 percent of ground-nesting species were using dredged material for nesting (more than 115,000 adults). Many ground-nesting waterbirds that usually nest on dredged material islands were nesting in the marsh drift with mixed success due to limited habitat.

4. From a local perspective, this study will be of direct value in managing and developing dredged material island habitats in New Jersey. A national perspective is presented in a report entitled "Development and Management of Avian Habitat on Dredged Material Islands" (4F03), which synthesizes island habitat research in New Jersey, the Great Lakes (4F01A), North Carolina (4F02), Florida (4F01C), Texas (4F01B), the Pacific Northwest (4F01E), and the Upper Mississippi River (4F01F).

John L. Cannon

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

18 WES

19 TR-D-78-1

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
Technical Report D-78-1

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
6 USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY.

5. TYPE OF REPORT & PERIOD COVERED
9 Final rep[redacted]t.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
10 Francine G. Buckley
Cheryl A. McCaffrey

8. CONTRACT OR GRANT NUMBER(s)
15 Contract No. DACW39-76-C-0166 new

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Manomet Bird Observatory new
~~Manomet,~~ Mass. 02345

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
DMRP Work Unit No. 4F01D

11. CONTROLLING OFFICE NAME AND ADDRESS
Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

12. REPORT DATE
11 Jun[redacted]78

13. NUMBER OF PAGES
205

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
U. S. Army Engineer Waterways Experiment Station
Environmental Laboratory
P. O. Box 631, Vicksburg, Miss. 39180

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; distribution unlimited.

12 668p.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES
Appendices A and B were reproduced [redacted] and are enclosed [redacted] inside the back cover of this report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Birds	Seabirds
Dredged material	Shore birds
Islands (Landforms)	
New Jersey	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The use of dredged material islands by colonial nesting seabirds and wading birds in New Jersey was examined in five major phases. The first located dredged material islands from Manasquan to Cape May Inlets, NJ; the second recorded the past history of all colonial nesting seabirds and wading birds in New Jersey; the third recorded the vegetation patterns and succession on 21 dredged material islands selected for intensive study; the fourth recorded the distribution in CONT

(Continued)

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

New 410963

20. ABSTRACT (Continued).

CONT.

1977 of colonial seabirds and wading birds in the study area and their utilization of dredged material islands; and the fifth documented those factors influencing the use and selection of dredged material islands by birds in 1977.

Plant communities were placed into 15 categories. The most important ones for birds on the dredged material study islands were bare, common reed, reed-shrub, shrub, shrub-forest, shrub-dense grassland, and dense grassland. More than 52,000 pairs of colonial seabirds and wading birds of 16 species nested in the study area. Their use of dredged material islands by percent of their total population ranged from zero (Forster's terns) to 71 percent (herons). No statistically significant vegetation differences were found between the 11 bird (colony) and 10 vegetation (non-colony) study islands, leading to the conclusion that other factors, notably microtopography, past history of colony success, and freedom from disturbance by quadruped predators and humans, may be the most important in determining island use by birds, given certain minimal habitat requirements.

Nineteen management recommendations for dredged material islands are stated, including annual wildlife surveys, careful monitoring of contractor performance, attention to record keeping, preservation of alternative colony sites, rotational use and management of dredged material islands, proportional habitat creation and management, and protection of all islands with bird colonies.

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SUMMARY

This report summarizes the results of investigations of the distribution of colonial seabirds and wading birds on New Jersey dredged material islands, of vegetation distribution and succession on dredged material islands, and of the interactions of vegetation and birds on dredged material islands.

Investigations were divided into five phases concerned with: (a) the location of dredged material islands along the 190.7-km length of the New Jersey Intracoastal Waterway, between Cape May Inlet and Manasquan Inlet; (b) the past history of colonially nesting seabirds and wading birds in New Jersey; (c) vegetation patterns and succession on 21 dredged material study islands; (d) the distribution of colonial seabirds and wading birds on dredged material islands along the New Jersey Intracoastal Waterway; and (e) the documentation of factors influencing the use and selection of dredged material islands as colony sites by colonially nesting species.

In New Jersey, barrier beach and salt marsh habitat left undisturbed and available to nesting birds has decreased drastically since the early 1900's. The salt marshes have been severely altered by dredging, ditching, and filling operations. Despite these alterations most of the colonial nesting species studied were nesting in considerable numbers on the islands and salt marshes behind the barrier islands.

Dredged material islands currently provide many of the colony sites for waterbird species formerly nesting on barrier islands. The specific study area contains nearly 200 islands or sites known or suspected to be of dredged material origin. Twenty-one dredged material islands were selected for detailed study of their vegetation and successional patterns. Eleven supported colonial bird colonies: six heronries, five gull colonies, two least tern colonies, and one common tern colony harboring a few pairs of black skimmers. Ten islands had no colonial nesting birds. The study islands ranged from high-domed and circular, through irregularly shaped and flat, to diked.

Plant seral stages, ages, major plant species, colonial seabird

and/or wading bird populations and island characteristics were recorded. Aerial photographs, bird colony maps, and vegetation maps are presented for each study site.

Vegetation field studies were conducted using four methods: (a) photointerpretation of false-color, infrared aerial imagery, (b) on-site vegetation sampling, (c) general field reconnaissance, and (d) calculation of areas covered by various vegetation mapping units. Vegetation maps were prepared for each study island. One hundred different plant specimens collected on dredged material islands were sent to the U.S. Army Engineer Waterways Experiment Station (WES) for preservation. Soil samples collected on each dredged material study island were also sent to WES for analysis.

The vegetation communities and seral stages found on the dredged material study islands were summarized. Species present were indicative of low tidal marsh, high tidal marsh, grassland, shrub-thicket, and dune woodland communities. Vegetation communities indicative of early, mid, and late seral stages of plant succession are described. Their distribution on the dredged material study islands is also discussed. Plant communities or species on study islands were found to be typical of southern New Jersey.

Colonial nesting bird populations were surveyed and censused using a Model 206B, Bell Jet Ranger helicopter. Colony sites on islands, salt marshes, and barrier beach islands 1.6 km to each side of the New Jersey Intracoastal Waterway were located. Breeding populations at smaller colonies were determined by actual count and by section counting at larger colonies.

Sixteen colonial waterbird species were found nesting in the specific study area: little blue heron, cattle egret, great egret, snowy egret, Louisiana heron, black-crowned night heron, yellow-crowned night heron, glossy ibis, great black-backed gull, herring gull, laughing gull, gull-billed tern, Forster's tern, common tern, least tern, and black skimmer. Forster's tern was the only species not associated in any way with dredged material. Laughing gull and gull-billed tern nested on some salt marsh sites that may have been of dredged material origin,

although they were predominantly natural salt marsh nesters. A total of 117 separate colony sites were located. Common terns and herring gulls were the most widespread species, occurring at 52 and 40 locations, respectively. Least terns and black skimmers, both endangered species in New Jersey, were found at 15 and 14 sites, respectively. A total of 32 wading bird colonies were present, many of them on older, inactive dredged material sites.

A total of 52,205 pairs of nesting colonial seabirds and wading birds was counted. Laughing gulls (35,241 pairs) were the most numerous and gull-billed terns (18 pairs) were the least numerous. Common terns and herring gulls had similar populations with 4667 and 4202 pairs, respectively. Snowy egrets (2,094 pairs) and glossy ibises (1,543 pairs) were the most numerous of the 5582 pairs of wading birds counted.

Analysis of habitat data was confined to examination of the general colony habitat and comparisons of population and colony site type distributions. Overlay maps of bird colonies and vegetation were made of each study site. Comparisons were made between vegetation communities on study islands with and without bird colonies.

Vegetation maps show 15 vegetation communities. Adjacent tidal flats were also noted as was the distribution of salt marsh drift vegetation on most of the study islands. Frequency, cover, and height data were obtained on various study islands, a "visibility index" was derived from combined cover and height values, the area occupied on each island was computed, and the presence or absence of plant communities across all islands was recorded. Data on island size, dredged material deposit size, and probable ages of study islands were compared between the vegetation and bird study islands.

The importance of dredged material islands to colonial seabird and wading bird populations in New Jersey was determined with the importance to individual species considered. The islands were of the greatest importance to wading birds, followed by great black-backed gulls, and herring gulls. Least terns also had a major portion of their population on dredged material. Common terns were found nesting mostly in salt marshes, probably forced there from more traditional barrier island

sites by development and their disturbance. Common terns seem to be unable to compete successfully with humans and herring gulls for the decreasing number of suitable sandy sites left in New Jersey. Black skimmers have nested in some numbers on dredged material sites in New Jersey but there is a scarcity of suitable bare sand sites for their colonies.

Avifaunal effects upon vegetation are briefly discussed; fecal enrichment on the colony nest site, mechanical destruction of vegetation, and seed transport were specifically considered.

Conclusions drawn from this study included recognition of the following needs: (a) a complete inventory of dredged material islands in New Jersey; (b) additional research on plant patterns and succession, taking into account such factors as island microtopography, water table levels, salinity factors in soil and water, salt spray, and tidal inundation; (c) other research of variables not programmed for this study such as previous colony nesting success, microtopography of the colony site, disturbance by humans, disturbance by quadruped predators, and adjacent beach development which, given certain minimum habitat requirements, are probably the most critical factors in colony site selection by colonial seabirds and wading birds; and (d) management of dredged material islands as a wildlife resource.

Nineteen management recommendations are made pertaining to the general management of dredged material islands as a wildlife resource, as well as specific management procedures for colonial seabirds and wading birds in New Jersey. They concern: (a) an inventory of dredged material islands; (b) wildlife surveys of dredged material islands; (c) the timing of dredged material deposition; (d) contractor waterbird surveys; (e) record keeping; (f) integration of inlet dredging with Intracoastal Waterway dredging; (g) needed research; (j) colonial waterbird surveys; (k) deposition on colony sites; (l) habitat surveys; (m) alternative colony sites; (n) rotational island management; (o) wading bird management; (p) proportional habitat representation; (q) island diking; (r) maintenance of bare sand habitat; and (s) protection.

Management recommendations offered herein do not constitute a complete management program for colonial seabirds and wading birds and dredged material islands. Rather, it is hoped that they will provide a starting point for further investigation and cooperation between all groups whose responsibilities include the management of dredged material islands and their avian wildlife resources.

PREFACE

The work described in this report was performed under Contract No. DACW 39-76-C-0166, titled "Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey," between Manomet Bird Observatory, Manomet, Massachusetts, and the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The study was conducted as part of the Office, Chief of Engineers Dredged Material Research Program (DMRP). The DMRP is sponsored by the Office, Chief of Engineers, and is assigned to WES under the Environmental Laboratory (EL).

In the DMRP, the study was part of the Habitat Development Project (HDP) and designed to determine the national significance of dredged material islands to colonially nesting seabirds and wading birds, and to develop a management program for dredged material islands as a manageable wildlife resource.

Field work and the initial report was prepared by Ms. Francine G. Buckley and Ms. Cheryl McCaffrey of Manomet Bird Observatory. Ms. Mary C. Landin, WES, was Contract Manager and contributed some figures and portions of text to the final manuscript, as well as located the dredged material islands in New Jersey. Dr. Robert F. Soots, Jr., WES, served as technical adviser. Ms. Landin, Dr. Soots, and Ms. Mary K. Vincent provided technical review.

The study was conducted under the general supervision of the following EL personnel: Dr. H. K. Smith, HDP Manager; Dr. Roger T. Saucier, Special Assistant for Dredged Material Research; and Dr. John Harrison, Chief, EL. COL John Cannon, CE, was Commander and Director, WES. Mr. F. R. Brown was Technical Director, WES.

Many persons provided expertise and help and their contributions are gratefully acknowledged: Dr. Joanna Burger, Rutgers University, provided access to unpublished and published field data as well as many hours of useful discussion about the many facets of this study. Mr. Richard Kane, Director of the Wildlife Research unit, New Jersey Audubon Society (NJAS), made essential resources available and gave access to the NJAS colonial waterbird survey results in both 1976 and

1977. Mr. Fred Lesser, Director, Ocean County, NJ, Mosquito Control Commission, contributed information about dredged material islands in New Jersey, bird distribution in Ocean County, and provided field assistance. Dr. Joseph Shisler, Rutgers University, also supplied information about Ocean County avifauna and dredged material islands. Messrs. William Shoemaker and Robert Mangold, New Jersey Division of Fish, Game, and Shellfisheries, and Ms. Joan Galli, New Jersey State Non-Game Biologist, provided useful discussion and information about the New Jersey State Endangered Species Program and additional data on colonial waterbirds in New Jersey. Ms. M. Pokras, Stockton State College, gave useful information on the Least Tern Protection Program in New Jersey. Messrs. Michael Bartlett and Gaylord Inman, U. S. Fish and Wildlife Service, were helpful with information about Brigantine National Wildlife Refuge. Mr. Bartlett also furnished information aobut dredging operations in New Jersey. Mr. Johan Wiese and Dr. R. Michael Erwin also contributed to this report through several useful discussions about colonial waterbirds in New Jersey and Delaware. Dr. Paul Godfrey, University of Massachusetts-Amherst, provided technical advice for the vegetation studies on this project. Dr. Harry E. Ahles, University of Massachusetts-Amherst, identified several and verified all plant specimens collected in New Jersey for this study. Mr. Roger Clapp, Bird Section, National Bird and Mammal Laboratory, provided access to the resources of the National Museum of Natural History throughout this study and provided assistance with avian literature. Mr. Robert Anderson, Norfolk, Virginia, assisted the principal investigator in the field, and Mr. N. Farante, Ronson Airways, Trenton, NJ, was the helicopter pilot. Ulla Soforenko, Mapmakers, Inc., drafted the bird overlay maps and final dredged material island and bird colony distribution maps. Mrs. Mary Duarte, Aid, Inc., typed the Phase III report and first draft final report. Dr. P. A. Buckley, National Park Service and Rutgers University, provided assistance with historical information on colonial waterbirds in New Jersey.

Administrative management for the Manomet Bird Observatory was provided by Mr. Joseph A. Hager, Managing Trustee, Ms. Kathleen S. Anderson, Executive Director, and Mr. Kenneth A. Youngstrom, Director of Contract Operations.

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USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY

PART I: INTRODUCTION

Background and Purpose of Study

1. This report was prepared under the sponsorship of the U.S. Army Corps of Engineers Dredged Material Research Program (DMRP). It is one of several studies, conducted on a nationwide basis, to assess the potential value of dredged material islands. The purpose of this study was to determine (a) the use of dredged material islands in New Jersey by colonial nesting seabirds and wading birds, (b) the succession of vegetation on dredged material islands used by these colonial nesting species, and (c) any relationships between succession of vegetation and colonial nesting species. The results of this study along with several similar studies in other parts of the United States will be used to provide information useful to the future creation, development, and management of dredged material islands as possible areas for wildlife habitat development.

2. The New Jersey study was divided into five phases: Phase I was concerned with the location of dredged material islands within the specific study area which coincided with the length (190.7 km) of the New Jersey Intracoastal Waterway from Cape May Inlet in the south to Manasquan Inlet in the North (Figure 1); Phase II was concerned with the past history of colonial nesting seabird and wading bird species in New Jersey, and data are presented in detail in Appendix A; Phase III was concerned with determining vegetation patterns and succession on 21 dredged material islands chosen for detailed analysis and these results are presented in Appendix B; Phase IV was concerned with the

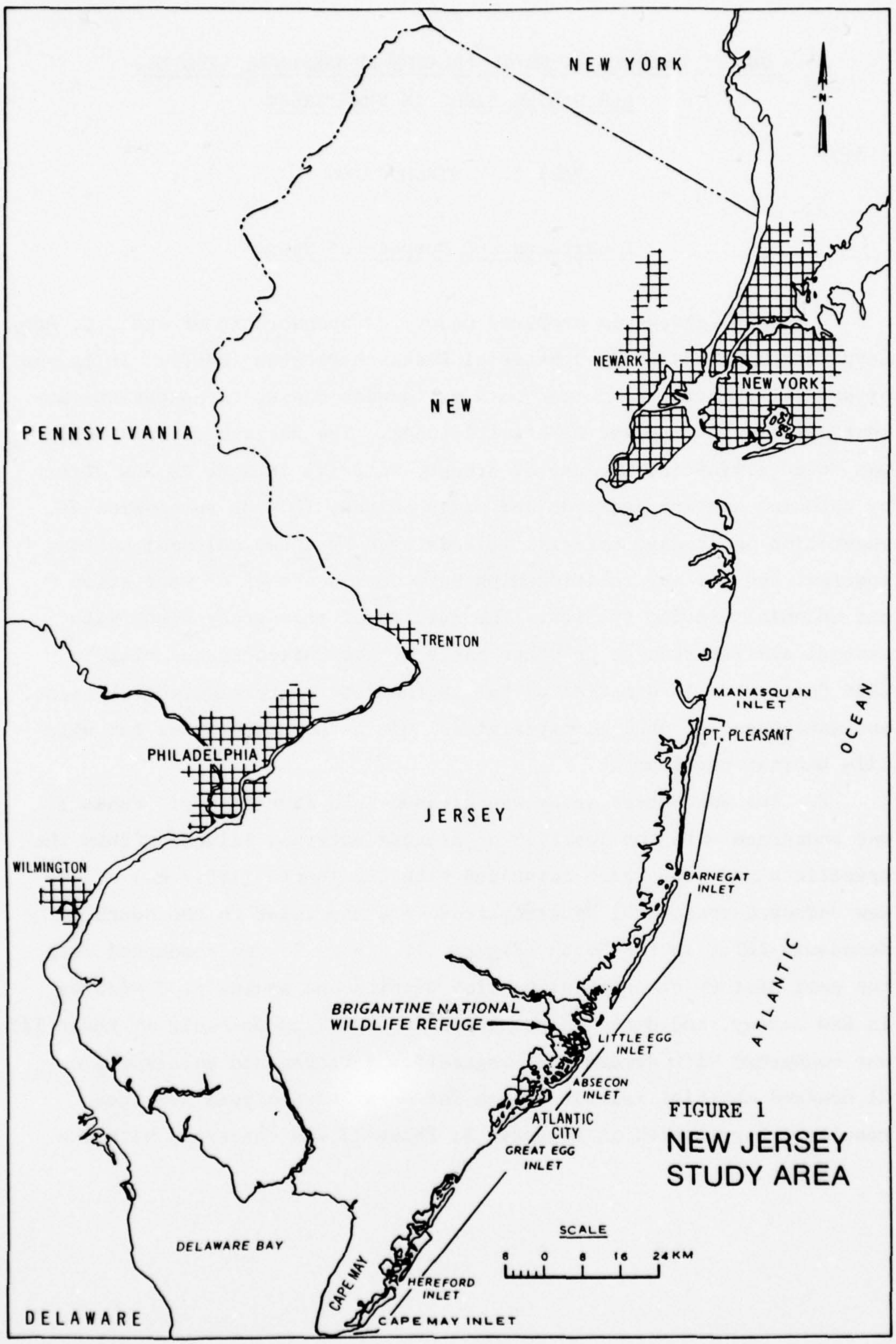

FIGURE 1
NEW JERSEY STUDY AREA

use of dredged material islands by colonial nesting birds in New Jersey during the 1977 breeding season; and Phase V was concerned with documentation of factors influencing the use and selection of dredged material islands as nest sites by colonially nesting species.

Literature Review

3. Scientific literature pertaining to the use of dredged material islands by colonial nesting seabirds and wading birds in New Jersey is relatively scarce. Stone (1937) presented one of the earliest references to bird use of dredged material sites in New Jersey. In the early 1970's Downing (1973), Fisk (1974) and Buckley and Buckley (1974) noted use of dredged material areas for nesting sites in the New Jersey area. More recently, Kane and Farrar (1976, 1977) also noted whether or not colonies were located on "spoil" sites in the colonial bird surveys sponsored by the New Jersey Audubon Society and U.S. Fish and Wildlife Service.

4. In 1928 Stone (1937) observed that common terns, black skimmers, and least terns were utilizing areas in the meadows (salt marshes) behind the barrier islands where sand dredged from the Intracoastal Waterway channel had been deposited. Stone also referred to black skimmers nesting behind Brigantine on a sand flat on the meadows resulting from "dredging out the channel." In 1925, Charles Urner wrote to Stone describing a "high sand island created by the dredging of the channel" north of Little Beach Island near Brant Beach, where he had located a pair of nesting black skimmers. This colony grew and was present until at least 1937 with up to 75 pairs breeding there. Stone also noted that in addition to sand placed upon the salt marshes being utilized as nest sites, low marsh islands "partly covered by dredgings of sand from the channel" were also being used by common terns for nest sites.

5. Least terns that require bare sand, gravel, or cobble for nesting were recognized by Stone as being in serious trouble in New Jersey because of the loss of beachfront colony sites from heavy

development in the 1920's, combined with the species' extirpation as a breeding species in New Jersey during slaughters by the millinery trade of the late 1800's. Stone's words written in 1937 are pertinent today...

> Unfortunately the status of the least tern is rather precarious since the beaches which are its true home are almost entirely taken over by building operations and resort developments while people and dogs constantly disturb the birds during the early summer when they should be free from persecution. Were it not for the recent sand flats left by the dredges in deepening the inland waterway they would probably ere now have again taken their departure. Whether they will permanently establish themselves on these more or less artificial nesting grounds remains to be seen.

Unfortunately, least terns and black skimmers are today both on the New Jersey endangered species list. Both species nest on frequently disturbed dredged material sites that interfere with these species' successful production of young.

6. The utilization of dredged material islands by wading birds (herons, egrets, ibises) in New Jersey has not been specifically discussed in the scientific literature except for brief mention of certain colonies as being located on "spoil islands" by Burger (1978) and Kane and Farrar (1976).

7. The importance of dredged material islands in providing comparatively undisturbed nesting habitat for colonially nesting seabirds and wading birds had been generally overlooked until the late 1960's and early 1970's, when several researchers independently began investigating the use of these sites as a wildlife resource. Preliminary nesting bird surveys of least terns by Fisk (1974) and Downing (1973) also helped to focus interest on dredged material sites as potential nesting habitat along the Atlantic coast. Florida (Carlson 1972), Texas (Barnes 1971, McMurry 1971, Simersky 1971), North Carolina (Soots and Parnell 1975a, 1975b; Buckley and Buckley 1973, 1974, 1977), Virginia (Buckley and Buckley 1974, 1977), and New York (Buckley and Buckley 1974, 1977) have all been the sites of some investigation into the use of dredged material islands by colonial nesting waterbirds. The potential of dredged material islands as sites that could be managed to provide desirable breeding habitat for colonial nesting species in areas

where natural habitat is no longer available or is becoming reduced through human activities, has also been studied and discussed in the literature by Soots and Parnell (1975a, 1975b) and Buckley and Buckley (1974, 1976, 1977).

PART II: MATERIALS AND METHODS

Description of the Study Area

8. New Jersey is the fifth smallest state, having a land area of only 12,084 km^2. It is 267 km long and only 91.7 km at its widest point. The 1970 census figures indicated that New Jersey had a population of over seven million people giving it a density of over 1600 persons per km^2. In addition, the state lies between two major urban population centers, Philadelphia to the south and New York City to the north. Coastal New Jersey extends from the top of Sandy Hook spit to the tip of Cape May Point, a distance of 241 km. This area continually faces heavy population pressures for recreational and living space (Buckley and Buckley 1977) with the accompanying coastal development.

9. The specific study area in New Jersey was the area along the length of the New Jersey Intracoastal Waterway, 190.7 km from Manasquan Inlet to Cape May Inlet (Figure 1). This area coincides with New Jersey's barrier islands, barrier spits, coastal salt marshes (salt meadows), major back bays and lagoons, and numerous dredged material islands. It traverses Ocean, Atlantic, and Cape May counties and provides habitat for colonial nesting seabirds and wading birds.

10. While historically most of these species were dependent upon New Jersey barrier beaches for colony nest sites, most were and are still dependent upon the New Jersey salt marshes for their food. With the development of barrier beaches and attendant heavy recreational use, many formerly beach-nesting species are now also dependent upon the salt marshes and bays for nest sites as well. In 1954, New Jersey had 97,388 ha of coastal wetlands. By 1968, 10.5 percent of these had been permanently destroyed (Robichaud and Buell 1973). New Jersey has almost 10 percent of the total wetlands along the Atlantic coast and more of than half of those have been severely modified (Gusey 1976, Jacobsen 1965, Crawford 1974). Within New Jersey, salt marshes represent only 4.5 percent of the total acreage. However, they support the state's

finfish and shellfish industries and those of other east coast states as well.

11. The most serious changes in the New Jersey salt marshes have resulted from their physical alteration by human activities. Efforts to control mosquitoes in the early 1900's resulted in the draining of rich and productive shallow pools and pannes. Ditching of the salt marshes was begun in 1912 and greatly expanded in 1933 when large amounts of labor were available during the depression. Ditching is still used by mosquito control commissions in New Jersey, and their efforts have greatly modified the salt marshes since the early 1900's. During this time, heavy widespread construction on the oceanfront and increasing demand for land in this area led to filling and dredging activities in addition to those begun in 1908 for navigation channels (Nordstrom et al. 1974). These activities carried on by various Federal, State, municipal, and local bodies, as well as by individual land owners, had little or no regulation, so destruction of large areas of salt marsh occurred when high spots were created. Dredged material islands were apparently created on pre-existing salt marsh or pre-existing salt marsh islands, as well as in shallow bay waters behind the barrier beaches and in inlet areas, although little or no record of their creation exists.

12. A more detailed account of the study area and its present and past development is provided in Appendix A. Today the area is very heavily developed above the Island Beach (now a state park). Varying degrees of development are present on the barrier islands below here. Brigantine National Wildlife Refuge provides over 8173 ha of protected salt marsh area and is heavily utilized by colonial nesting species. Stone Harbor Sanctuary, a municipally owned wildlife refuge, and one of the last remaining pieces of maritime forest left on the Jersey coast, harbors the largest heronry in New Jersey. Heavy recreational use and development of New Jersey beaches have left very few undisturbed areas for nesting birds to utilize. Despite the intensive development of the barrier beaches, the marshes and bays behind them are still comparatively undisturbed though mostly ditched. Dredging operations

have produced a number of islands in these marshes and these, coupled with other high spots of undertermined, but suspected, dredged material origin throughout much of the south Jersey marshes have provided alternatives to the former nesting sites destroyed on the barrier islands. It is here that most of the species examined in this study are now found.

Dredged Material Sites

13. The specific study area contains numerous islands that are of dredged material origin. The New Jersey portion of the Intracoastal Waterway was constructed by the State from 1908-1916 and was later turned over to Federal control in 1945 (Nordstrom et al. 1974). The State maintained the channel at a depth of 1.8 m and the U. S. Army Engineer District, Philadelphia, the Federal agency that is now responsible for its maintenance and operation, has also maintained a channel depth at 1.8 m. In New Jersey, a channel depth of 3.1 to 3.7 m is maintained to provide for ferries and larger boats. The dredging operations associated with maintaining this navigation channel have been responsible for the deposition of a large part of the dredged material in the specific study area in New Jersey. Records of the precise locations where this material was deposited were not systematically kept by either the State or the U.S. Army Corps of Engineers until recently, so the exact determination of locations of islands of dredged material origin in New Jersey has been extremely difficult. Compounding the lack of State or Federal records were the dredging and filling activities of local and private interests with little or no supervision. Local mosquito control ditching activities also contributed to dredged material deposition on the salt marshes, salt marsh islands, and shallow waters of this area. State officials now consider any areas of higher elevation in the marshes to be of probable dredged material origin (personal communication, December 1976, Dr. Tom Hampton, Office of Wetlands Management, New Jersey Department of Environmental Protection, Trenton, New Jersey).

14. A study concerned with the environmental impact of maintenance

dredging of the New Jersey Intracoastal Waterway was published (Nordstrom et al. 1974) by the Marine Sciences Center of Rutgers University, New Brunswick, New Jersey. This study indicated sites along the waterway used for dredged material disposal or recommended as alternative sites in 1974 appeared upon inspection in 1977 to have been used some time in the past for disposal. Ages or dates of last deposition of these sites were not provided in Nordstrom et al. (1974). A "Final Environmental Impact Statement" issued by the Philadelphia District in 1975 is based upon the Nordstrom report.

15. The Ocean County Mosquito Control Commission, concerned with the problem of disposal locations acting as mosquito breeding grounds (Shisler 1977) and especially the diked disposal areas where improper drainage and standing water provide prime mosquito breeding habitat, instituted a study to collect and evaluate data concerning mosquito problems associated with dredged material sites in New Jersey. As part of that study, several dredged material disposal areas were located. Additional data on locations were obtained from the Ocean County Mosquito Commission but dates of deposition were not available.

16. Figure C1 of Appendix C presents the locations of dredged material study islands whose dredged material origins were recorded by either the U. S. Army Corps of Engineers or the Ocean Study Mosquito Commission. A listing of definitely known dredged material sites along the New Jersey Intracoastal Waterway, including their latitude, longitude, names (if available), and estimated (in most cases) size and age, is found in Table C1.

Study Island Selection

17. Final selection of 10 dredged material sites without and 11 dredged material sites with colonial nesting seabirds and wading birds for intensive analyses of vegetation and avifauna was made in early June 1977. Study islands tentatively selected in May for intensive study later proved to be infeasible for use as study islands. Plans by the Philadelphia District of the U.S. Army Corps of

Engineers to use several previously selected sites as dredged material disposal areas during May-August of 1977 precluded their use as study islands. A number of sites that had been selected for study in May because they supported appropriate vegetation and no colonial nesting species were found to have nesting birds in June. Conversely, several islands selected in May, because of wading birds nesting on them, were found deserted in June. Thus final selection of islands was not possible until the second survey in June.

18. Parameters used in selection of study islands with colonies were based upon the avian species composition and population of the island, as well as its location and age if known. Eleven sites supporting bird colonies were selected because one dredged material site had two distinct dredged material deposits physically separated by salt marsh and creeks, each one supporting a heronry with one also supporting a gull colony. Vegetation study islands were selected for comparison to those supporting colonies based upon a best approximation of their similarity in size, location and habitat. Age data, when available, were also an important factor. Consideration was also given to attainment of an equitable distribution of study sites along the length of the New Jersey Intracoastal Waterway in order to include the possiblilty of geographic variation in plant composition acting as a factor in colony site selection.

19. Study island locations are shown in Figure C1 and their physical and biological characteristics are discussed in detail in Appendix B, as well as in Part III of this report.

Vegetation Studies

20. In order to determine patterns of succession of vegetation on dredged material study islands, several methods of analysis of the vegetation growing on these islands were employed. Appendix B presents a detailed discussion of these methods. A summary is presented here.

Photointerpretation

21. Major plant communities were mapped using false-color infrared

Ektachrome transparencies of each study island, taken as part of the study during July-August 1977 from an altitude of 308 m. Photointerpretation was augmented by onsite ground truthing. Photointerpretation and analysis followed standard procedures (Anderson and Webber 1973, Avery 1968, Fornes and Reimold 1973). Initial analysis produced 43 tentative recognizable plant associations which were reduced to 15 plant communities. Vegetation maps were prepared from these 15 plant community designations, which were based upon dominant species composition, ground cover, and visual density. Onsite ground truthing and field transects enabled accurate determination of photographic scales and distances.

Sampling techniques

22. Ground sampling techniques included general field reconnaissance, line intercept, and quadrat sampling methods (Oosting 1958, Phillips 1959). All study islands were surveyed aerially by fixed-wing aircraft, and photographs and notes pertaining to their vegetation were taken. Ground sampling techniques and visual observation were used to determine criteria for classification of frequency, cover, and height classes for dominant or major plant species found on the 21 study islands. Table B1, Appendix B presents these classes and their equivalents. Four frequency classes were determined based upon species presence in quadrats. Cover was divided into five classes based upon the percent of ground covered in all quadrats. Height was divided into six classes ranging from 0 to 10.0 m. Dominant plant species were determined by their frequency of occurrence across all quadrats sampled on all study islands. Species exhibiting the highest percent frequency and having a cover class of at least 6 to 25 percent were determined to be dominant species. The area covered by each study island and plant community was determined by use of a dot grid.

Preservation of specimens

23. Specimens of 100 plant species were collected on the study islands. Species verification and/or identification was made by Dr. Harry E. Ahles, Herbarium Curator at the University of Massachusetts, Amherst, MA and co-author of The Manual of the Vascular Flora of the

Carolinas. Five species were not collected and are so noted in Table 3. Voucher specimens are on file at WES.

Substrates and Soils

24. Dredged material removed from the New Jersey Intracoastal Waterway consisted of sand, clay, silt, peat, pebbles, and shell and varied with location along the Waterway (Nordstrom et al. 1974). Soil samples representative of the upper 15 cm of soil were collected in the major plant communities on each study island. Samples were collected both along transect lines and within major plant communities not along transect lines. Samples were collected on all study islands and labeled as to island, location on the island, and date. Approximately 45 kg of soil samples were shipped to WES. Soil analysis was not a part of this study, though it is hoped that these samples can be analyzed chemically and physically in order to help determine factors affecting growth and succession on dredged material islands in New Jersey.

Avifaunal Studies

Survey of colony sites

25. The length of the New Jersey Intracoastal Waterway was surveyed during early May 1977 and again during the first two weeks of June 1977 to locate colonies in the specific study area. In the May survey, barrier beaches bordering the Intracoastal Waterway were surveyed as well as the salt marshes and bays surrounding the Waterway. The June survey area was confined to the length of the Waterway and to a 1.60-km-wide swath to either side of the midline of the Waterway channel. In some instances, colonies located during the May survey were surveyed again in June despite being outside of these boundaries.

26. The locations of colonies observed during these surveys were noted on hydrographic charts numbered 12,324 (Sandy Hook to Little Egg Harbor) and 12,316 (Little Egg Harbor to Cape May), published by the National Oceanic and Atmospheric Administration in January 1977. Sites

of 1976 colonies were inspected closely as were sites observed to have appropriate species flying to, from, or around them, as well as birds loafing or feeding upon them, or nearby.

27. The conveyance used for both surveys was a five-passenger (including pilot) Bell Jet Ranger 11, Model 206B helicopter. An observer was positioned on each side of the machine in the rear and a third observer was seated next to the pilot in the front. The speed flown during surveying operations was relatively slow during the actual surveying activities. Surveying altitudes varied from 15 to 60 m depending upon location and development or obstructions in the areas being flown over.

28. Island and barrier beach locations were surveyed by flying directly over them. Salt marsh areas were surveyed by flying in a looping grid pattern and in decreasing concentric circles. When birds were observed, altitude and speed were reduced, and the site was circled to determine if actual nesting was occurring. In some areas where nesting was in doubt but there were numbers of birds present, it was necessary to hover over the location (at a distance safe enough to cause no damage to the site from blowing debris or prop wash) to determine if nests were present. This was done most often in small heronries where nests were not immediately visible. Once a colony nesting site was located, counts were made.

Census of colony sites

29. Census techniques used in this study were concerned with the determination of the species present and the numbers of breeding adults inhabiting each colony. The term "census" is used as defined by Buckley and Buckley (1976).

30. Once a site was determined to harbor an active colony, the altitude and speed of the helicopter were reduced and the colony was circled in both a clockwise and counterclockwise direction so that observers on both sides of the aircraft could observe the colony and its inhabitants. Population determinations followed procedures already field tested during colonial waterbird censusing on Long Island, NY (Buckley et al. 1977).

31. Breeding adults in smaller colonies (under 150) were counted, either as they flew off their nests or while they sat on them. In some instances, nests were also counted when they were visible, as were clutch sizes and the number of young present in the nests. In large colonies, the site was circled several times in both clockwise and counterclockwise directions, sectional counts being taken and totalled to obtain the total population per species. Use of the helicopter's hovering abilities facilitated censusing in large colonies, especially of heronries in dense vegetation. In these situations, hovering was used at a safe distance from the colony while counts were made of breeding adults. This procedure afforded an excellent view of birds flying in and out of the colony, of nest locations, and of nest contents. It was possible to count birds nesting at the lower levels of the canopy as well as birds scurrying through vegetation beneath the canopy.

32. Census methods also included the deliberate flushing of common, least, and Forster's terns from their nests by hovering at an altitude of approximately 15 m over colony sites. The birds were then counted either singly or by extrapolating from the number of birds in a small section of the flying flock multiplied by the approximate number of similar sections. This technique caused minimal disturbance of short duration (1 to 5 minutes) and also enabled observation of the reproductive stage of the colony. Many birds seemed habituated to this form of disturbance and did not leave their nests, clinging to them despite strong downdrafts created by the aircraft's main rotor. Almost all returned to their nests within 2 to 5 minutes after being censused.

33. Colonies located on dredged material islands selected as study islands were also censused by onground methods. The helicopter was set down in an area as far from the actual colony site as possible, which allowed investigation of the entire site with only minimal disturbance to the nesting birds. The colony was first inspected from its periphery. The locations of nests and species were noted and then the colony area was entered. Species composition and population were observed as the birds left their nests. Nests that were visible were investigated as to their contents and construction materials. Their

substrate was also noted. Counts were made of the birds flying over their nesting as well as those sitting on their nests or nearby roosts. Colony sites that were densely vegetated and/or densely populated were not traversed when disturbance factors outweighed the necessity for data gathering from the ground. In colonies where disturbance would be minimal, nests were counted in addition to the adult population.

Recording of data

34. Data gathered during aerial surveying, ground truthing, and censusing of the study area and of dredged material islands were recorded on field data sheets designed especially for this project (Figure 2). Data gathered included: colony name, site latitude and longitude, date, time, dredged material island number, the colony areal extent, county, if the island was diked or undiked, colony number, general colony habitat, colony history (if known), with any other pertinent data under a remarks category, species present, total population in pairs, nesting stage, and the nest site substrate. The categories of general colony habitat, colony areal extent, nesting state, and nest site substrate were given numerical codes (Table 1) corresponding to the various habitats, position on the colony site, stage of the reproductive cycle, vegetation, and soil substrates found within the study area. The colony number and location were recorded on hydrographic charts for later reference. Figure C2 in Appendix C shows the colony sites recorded in 1977 along the New Jersey Intracoastal Waterway. In some instances colony sites are shown despite their location outside the boundaries of the specific study area.

35. Aerial color photographs (35-mm transparencies) were taken of each colony site at the time of the census and survey. Sketches of the colony sites and vegetation on the study sites were also made and photographs (color, 35-mm transparencies) were also taken of the colony sites from the ground.

Data disposition

36. Field data sheets, hydrographic charts showing colony site locations in 1977, 35-mm color transparencies of colonies of colonial

COLONIAL WADING BIRD AND SEABIRD AERIAL SURVEY - N.J. INTRACOASTAL WATERWAY - 1977

COLONY NAME ____________

LATITUDE ______ LONGITUDE ______ DATE ______ TIME ______

DREDGED MATERIAL IS. # ______

DIKED ______ UNDIKED ______

COLONY AREAL EXTENT ______

COUNTY ______

COLONY # ______

GENERAL COLONY HABITAT ______

COLONY HISTORY ______

REMARKS ______

SPECIES PRESENT	TOTAL POPULATION	NESTING STAGE	NEST SITE SUBSTRATE

Figure 2. Field Data Sheet

Table 1

Key to Field Data Codes

COLONIAL WADING BIRD AND SEABIRD AERIAL SURVEY - N.J. INTRACOASTAL WATERWAY - 1977

KEY TO DATA SHEET CODING

I. GENERAL COLONY HABITAT

1. salt marsh 2. salt marsh island 3. dredged material island 4. island of unknown origin 5. barrier island 6. marsh island with dredged material deposition 7. salt marsh w/ dredged material deposition 8. construction fill 9. barrier island spit 10. natural sand shoal

II. COLONY AREAL EXTENT

1. scattered throughout island 2. scattered around island edge 3. scattered over island center 4. scattered over one end of island 5. clustered at island center 6. clustered at one end of island 7. scattered over salt marsh 8. clustered in salt marsh 9. other

III. NESTING STAGE

1. pairing/courtship 2. territory establishment 3. nest building 4. egg-laying 5. incubation 6. hatching 7. young in nest 8. young out of nest 9. young ready for flight/flying 10. loafing at site

IV. NEST SITE SUBSTRATE

1. trees-coniferous 2. trees-deciduous 3. trees-mixed 4. tall shrubs [above 3M.] 5. medium shrubs [1-3M.] 6. low shrubs [less than 1M.] 7. mixed shrub-*Phragmites* 8. *Phragmites* 9.herbaceous [non-grass] 10. grasses 11. salt marsh wrack 12.salt marsh 13. sand 14. sand-shell 15. sand-shell-gravel 16. other

---

seabirds and wading birds nesting in the specific study area, 35-mm transparencies of dredged material islands along the New Jersey Intracoastal Waterway, and false-color, infrared aerial imagery of the 21 dredged material study islands in New Jersey, were sent to WES.

Analysis

37. Analysis of the data was confined to examination of the general habitat of all colonies located on these surveys. The population numbers of the species censused, as well as the number of colony sites found in each of the ten habitat types, were compared. Data gathered on the 11 dredged material bird study sites were analyzed in more detail. The environmental setting of each colony was examined in detail. Bird colony maps for each study island were prepared as overlay maps to be fitted over the vegetation maps of the study islands. The colony area and each part of the colony within differing plant communities were determined from these maps by use of a dot grid.

38. Plant communities on study islands without bird colonies were compared to plant communities on study islands with bird colonies, with emphasis being placed upon those plant communities present within colonies. It was necessary to analyze plant communities in detail to determine similarities and differences between the 21 study islands. Statistical tests were used to determine the significance of relationships and differences and to look for relationships among islands, plant communities, and bird colonies.

39. Statistical methods. All statistical testing and mathematical computations were done on a programmable pocket computer using preprogrammed statistical tests, or by writing programs for short, repetitive tests when those were not already avilable. General statistical references used were Sokal and Rohlf (1969) for parametric tests and Siegel (1956) and Conover (1971) for nonparametric tests. The level for all tests was $P \leq 0.05$.

40. Frequency, cover, and height vegetation data. Frequency, cover, and height classes for each dominant species in each plant community sampled were averaged to obtain one set of frequency, cover, and height scores for each community on a dredged material study island.

Vegetation on islands with birds was statistically compared to islands without birds through T-tests.

41. Importance values were not calculated. Cover and height scores were added whenever available for plant communities on each study island.

42. Plant community distribution. To compare plant species occurrence and associations, the homogeneity of distribution was tested with the Cochran Q-test. Plant communities on all study islands were scored as present (+) or absent (-) on both vegetation and bird study islands in two row-by-column formats. They were analyzed on a bird islands vs. vegetation islands and herons islands vs. all other islands basis comparison using T-tests.

43. Avian and vegetation diversity indices. In an attempt to quantify both vegetation and bird diversity by use of a single measure, Shannon-Weiner (Wilson and Bossert 1971, Pielou 1977) Indices of Diversity $\{H' = -\Sigma P_i \ln P_i\}$ were calculated for each study island. Raw data were percentages of hectares occupied by each plant community on each island and the percent occurrences of each wading bird species on each bird study island (Pielou 1977). Plant diversity indices for all vegetation study islands and bird islands were pooled separately and compared by use of t-tests. Possible relationships between plant diversity indices and the age (based upon the last known date of dredged material deposition) of each deposit were investigated by the use of regression analysis, using plant diversity indices as the dependent variable and age as the independent variable. Plant diversity was regressed on deposit size. Bird groups other than herons were not studied in this manner because they were not sufficiently diverse in colony species composition to warrant this analysis.

44. Avian and vegetation association data. Detailed analyses of the interactions between birds and vegetation were generally pursued for only the wading birds, as they were the only group found on enough study islands with large, mixed-species colonies of sufficient size and dimensions to allow this. Herring gulls, though occasionally containing a few great black-backed gulls in their colonies, were the only other

birds occurring in large enough numbers and at enough study sites to warrant analyses. Cochran Q-tests were used for analysis.

45. An association matrix of possible combinations of eight major variables for possible investigation was devised. Included were: island size, deposit size, colony extent, bird density, bird species diversity, planting community diversity, the combined percentages of common reed (*Phragmites communis*), common reed-shrub, shrub, and shrub-forest communities occupied by the colony on each heron island, and colony size. Regression analyses were done between certain variables and certain data distributions and/or variable interrelationships necessitated data transformations before the assumptions of linear regression analysis could be met.

46. Regression analysis was used to investigate the relationship between plant diversity indices on study islands supporting heronies and (a) plant diversity indices for vegetation study islands only, and (b) for all study islands excluding those with heronries. It was also used to examine relationships between plant diversity indices of study islands and between plant diversity indices for all bird and vegetation study islands. All regression slope coefficients were tested for significant deviations from a slope of zero by the use of t-tests.

PART III: RESULTS

Dredged Material Study Islands

47. Twenty-one dredged material islands were chosen for detailed study of vegetative and physical characteristics that could possibly affect the selection or rejection of dredged material islands as breeding colony sites by seabirds and wading birds. Eleven of these sites supported active bird colonies during June 1977 when field studies were undertaken. These colonies were examined to elucidate factors used in colony site selection by the birds. One dredged material site, 98B, had two distinct dredged material deposits upon it and each supported an active heronry. (The terms "heronry" and "herons" are used collectively in this report to include egrets, ibises, and herons.) Thus, this site consisted of two separate study islands, 98B North and 98B South, separated by creeks and salt marsh, increasing the number of study sites actually supporting bird colonies to 11 sites. Ten sites did not support active bird colonies during June 1977 when surveyed and these were considered vegetation study islands, or "control sites." Overlay maps of the bird colonies were prepared for each bird study island, and vegetation maps were prepared for all study islands. Physical characteristics determined for each study island included: (a) island and/or dredged material deposit size; (b) latitude and longitude; (c) date of last known dredged material deposition; (d) elevation; (e) distance from the New Jersey Intracoastal Waterway; (f) presence and estimated extent of adjacent tidal flats; and (g) presence or absence of diking. Table 2 gives these characteristics for each study island. Bird colony data for each bird study island are listed in Appendix C. A detailed analysis of vegetation on each study island is presented in Appendix B.

Table 2

Physical Characteristics of Study Islands

Island #	Island Size (ha)	Deposit Size (ha)	Diked (D)/ Undiked (U)	Date of Last Deposit	Elevation (m)	Tidal Flat Extent (ha)	Distance to NJICW (km)	Tidal Range (m)
A12	2.61	2.30	U	pre 1969	2.4-3.6	1.26	1.20	0.15
A12 North	6.38	0.61	U	pre 1969	1.5-2.4	---	1.33	0.15
A35	2.49	1.20	U	pre 1969	1.0-1.5	---	0.16	0.3
A43a	8.08	1.13	U	?	<1.0	---	0.28	0.67
45A	5.58	2.55	D	1976	1.5	---	0.08	0.67
45B	1.62	1.05	U	1963	<1.0	---	0.12	0.67
X27	13.17	0.69	U	pre 1969	1.0-1.5	1.75	0.40	0.79
51B	16.97	1.78	U	1965	1.0	---	0.32	0.79
A61c	5.49	3.47	U	pre 1969	1.0-1.5	---	0.12	1.03
A59a	2.42	2.42	U	1968	1.0	1.21	adj.	1.03
85dmi	3.07	2.38	U	1966	<1.0	---	adj.	1.1
85 South	13.63	0.70	U	1966	0.5	---	adj.	1.1
98A	5.94	0.76	U	1968	<1.0	5.05	0.20	1.3
108B	2.83	0.20	U	1965	<1.0	0.17	adj.	1.3
98B North	14.54	0.47	U	1968	<0.5	1.33	adj.	1.3
98B South	14.54	0.89	U	1968	<0.5	1.33	adj.	1.3
78B South	50.90	3.43	U	1969	1.0-2.0	---	0.40	1.2
103	129.28	1.18	D	1975	0.31	0.31	adj.	1.2

(Continued)

Table 2 (Concluded)

Island #	Island Size (ha)	Deposit Size (ha)	Diked (D)/ Undiked (U)	Date of Last Deposit	Elevation (m)	Tidal Flat Extent (ha)	Distance to NJICW (km)	Tidal Range (m)
85C	13.[illegible]	3.96	D	1976	1.5	0.14	adj.	1.1
109	81.0	5.28	U	1965	1.5	5.30	adj.	1.3
109 South	5.00	5.00	U	1965?	1.0	0.3	adj.	1.3

Description of Islands

Study Island A12, Pelican Island

48. Study Island A12 (Pelican Island) is a circularly shaped, high-domed island partially covered with undiked dredged material. Located in Ocean County at 39^{o} 57' N and 74^{o} W, it is approximately 2.6 ha in size with a dredged material deposit approximately 2.3 ha in size. The deposit area comprises all but a thin marsh and sand fringe of the island. An elongate salt marsh island lies between A12 and cottages on the barrier beach at Ortley Beach, only 1.8 km away. The study island is close to three marinas and receives frequent human visitation. A sandy spit on the southwestern side and the entire western face are sites of heavy recreational use (picnicking, sun bathing, boating rest stops) from the nearby barrier beach communities.

49. Estimated elevation (2.4 to 3.6 m) of the island is the highest of those studied. The dredged material deposit predates 1969 (personal communication, June 1977, Fred Lesser, Ocean County Mosquito Control Commission, Barnegat, NJ). The tidal range on this island is 0.15 m, and 1.26 ha of tidal flats are adjacent to the island. The New Jersey Intracoastal Waterway is 1.20 km from the study island.

50. Pebbles (8 to 20 mm in size) mixed with sand and quahog shell fragments are found at the summit of the sparsely vegetated dome. The lower areas are composed mostly of sand, but also contain pebble and shell. A small amount of debris is scattered over the dome. The western or high energy side of the island is eroding to some degree. The usual circular dredged material deposit shape is flattened on the west side, and the sandy dome sloped down to the water's edge without the bands of marsh and upland vegetation found on the other sides.

51. Pelican Island has both early seral stage and mid seral stage vegetation. However, the island is characterized (Appendix B) as being an early seral stage island. The sparsely vegetated dome covers most of the island and its vegetation of low grasses consists mostly of: brome grass (*Bromus tectorum*), sand-grape (*Triplasis*

purpurea), vulpia (*Vulpia octoflora*), and tumble grass (*Eragrostis spectabilis*), and the herbs, small fleabane (*Erigeron pusillus*) and evening primrose (*Oenothera parviflora*). Taller herbs and grasses, seaside goldenrod (*Solidago sempervirens*), American beachgrass (*Ammophila breviligulata*) and common reed (*Phragmites communis*), occur around the lower half of the dome and are most frequent on the eastern side. Surrounding the sparse grassland is a band of common reed. Scattered bayberry (*Myrica pensylvanica*) and groundsel (*Baccharis halimifolia*) are occasionally found with the common reed, either singly or in small thickets. A thin band of salt marsh surrounds all but the western face (Figure 3).

52. The sparsely vegetated sand and pebble substrate of the study island is probably a major factor in its selection by a number of least terns (*Sterna albifrons*) as a colony nest site. Least terns nested on the island in 1976 (Kane and Farrar 1976), and during the 1977 survey and census, 76 least terns were observed loafing on the site. By 7 June 1977, 240 pairs of least terns had nests and eggs scattered over most of the dome (Figure 4). This colony is the largest least tern colony in New Jersey in 1977. The nearest least tern colony site is at Barnegat Inlet, a distance of 20.11 km.

Study Island A12 North, Pelican Island North

53. Island A12 North (Pelican Island North) is an irregularly shaped, undiked dredged material island. Located in Ocean County at 39° 57' N and 74° 05' W, it is west of Ortley Beach, New Jersey, and directly north of study island A12. The dredged material deposit is about 1.6 ha in size and the entire island is approximately 6.4 ha in size. The dredged material deposit was built before 1969 (F. Lesser, 1977, personal communication). The island is located within 1.8 km of marinas and cottages on the barrier beach and receives frequent human recreational use on its sandy beach from boaters and local residents. The island's elevation was estimated to be 1.5 to 2.4 m, and its tidal range was 0.15 m. Its distance from the New Jersey Intracoastal Waterway

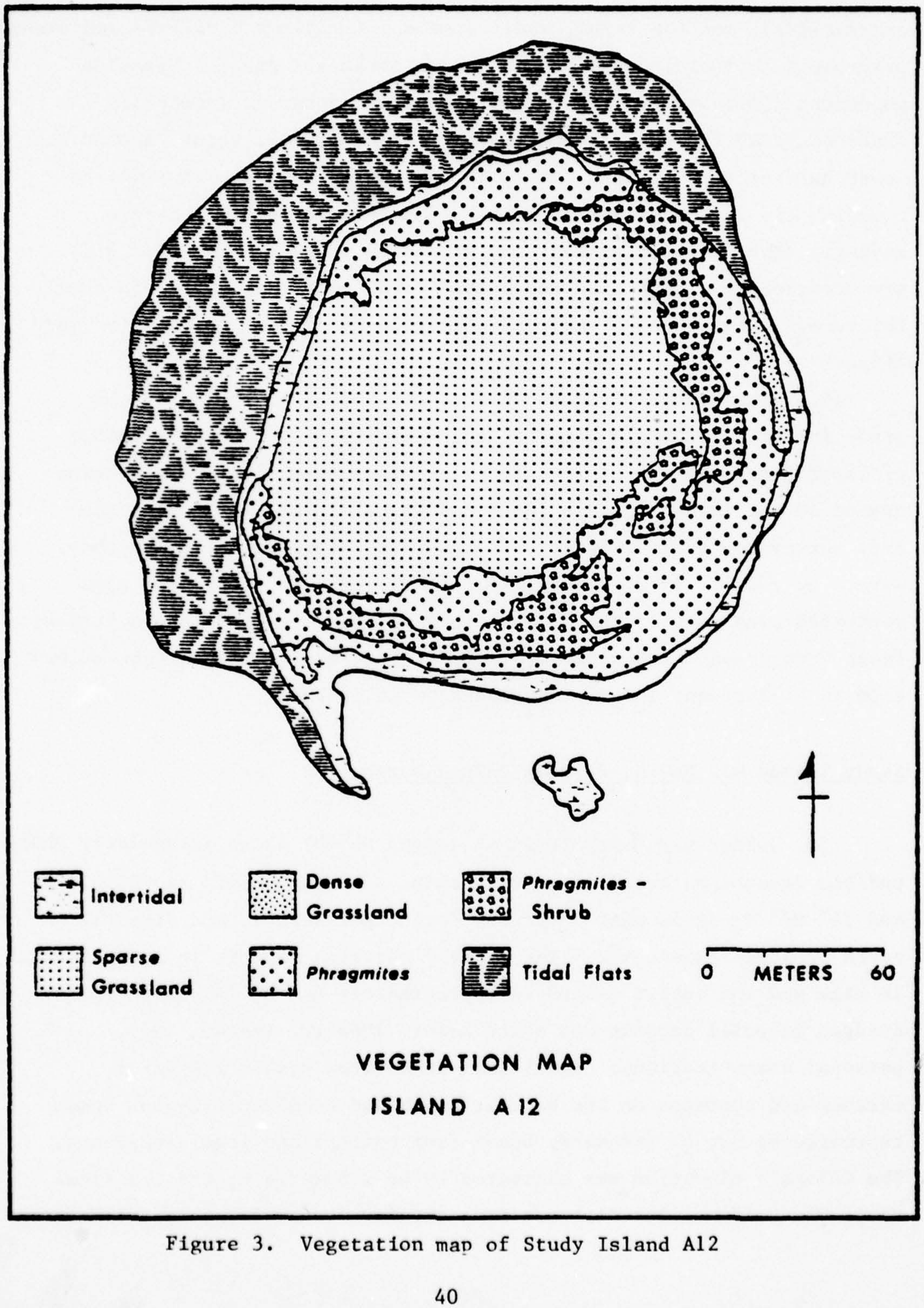

Figure 3. Vegetation map of Study Island A12

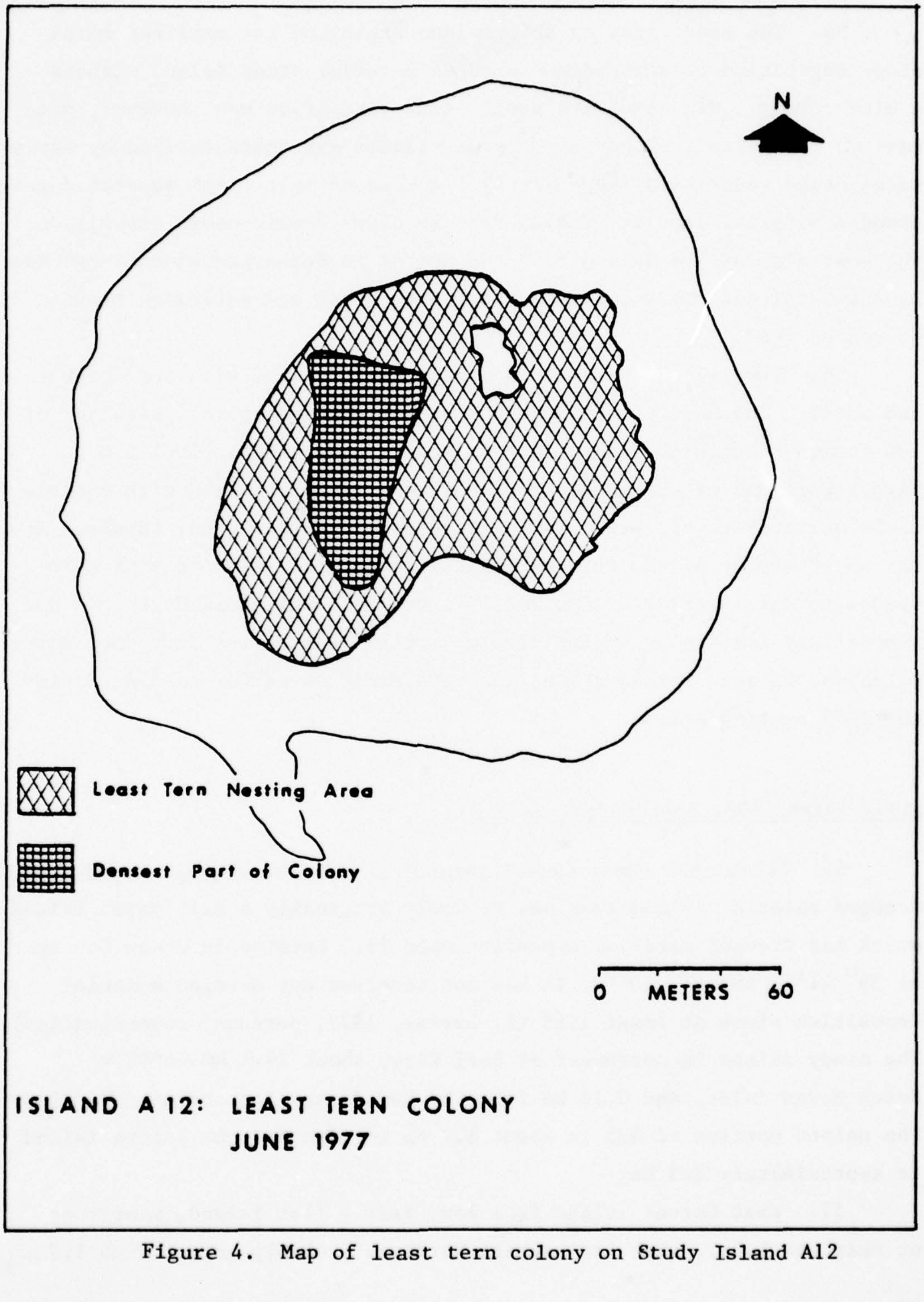

Figure 4. Map of least tern colony on Study Island A12

is 1.33 km. No extensive tidal flats were observed.

54. The study area on this island exhibited the earliest seral stage vegetation of any undiked dredged material study island without a bird colony. Mid and late seral stage vegetation was, however, present on the island, although the area studied was characterized by early seral stage vegetation (Appendix B). A band of salt marsh separated the dredged material deposit studied from an older double-domed deposit on the west side of the island that had sparse to dense grassland surrounded by shrub thickets that contained scattered trees and extensive stands of common reed.

55. The island had a domed center of bare sand with some pebble and shell. The base of the dome was encircled by a sparse grassland of low common reed which graded into taller reed approximately 1.5 m high. Portions of the common reed covered area were mixed with individuals or thickets of 1-to 1.5-m-high bayberry and groundsel shrubs. At the upper border of the salt marsh, the common reed mingled with saltmeadow cordgrass (*Spartina patens*) (Figure 5). While A12 North did not support any seabird or wading bird colonies, least terns from the nearby colony on Pelican Island did utilize its sandy areas for loafing during the 1977 nesting season.

Study Island A35, East Carvel Island

56. Island A35 (East Carvel Island) is an irregularly shaped, undiked dredged material island that was probably originally a salt marsh island which had dredged material deposited upon it. Located in Ocean County at 39° 41' N and 74° 10' W, it has not received any dredged material deposition since at least 1969 (F. Lesser, 1977, personal communication). The study island is northwest of Surf City, about 24.1 km north of Beach Haven Inlet, and 0.16 km from the New Jersey Intracoastal Waterway. The upland portion of A35 is about 1.2 ha in size and the entire island is approximately 2.5 ha.

57. East Carvel Island is a low, fairly flat island, mostly at or near sea level, with its highest portions probably only 1.0 to 1.5 m

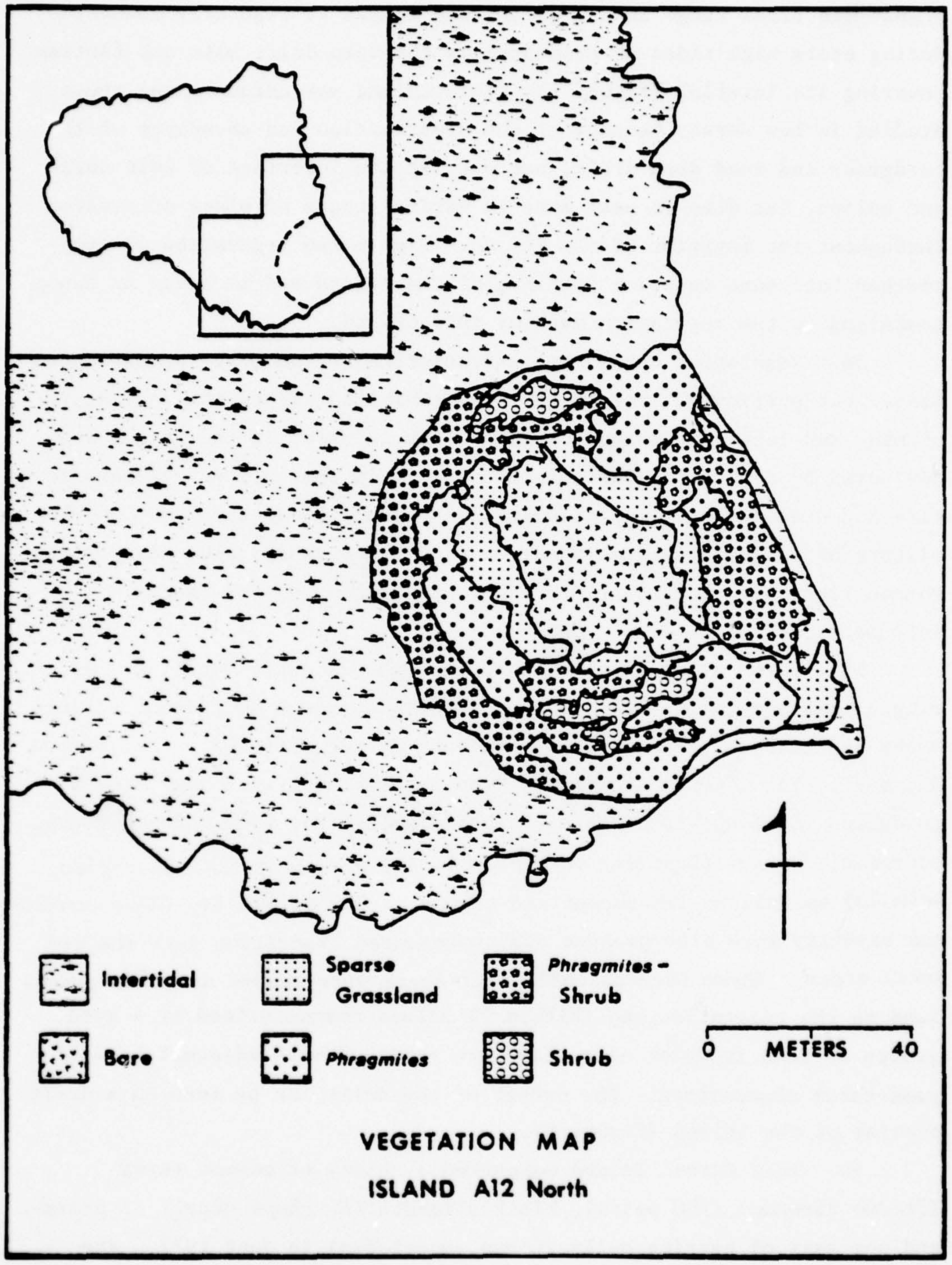

Figure 5. Vegetation map of Study Island A12 North

high. Its tidal range is 0.3 m, and the island is regularly inundated during storm high tides as evidenced by the deep drift mats and flotsam covering its interior (Figure 6). This island was unique among those studied in New Jersey because of the distribution and abundance of the cordgrass and reed stem drift, not only at the interface of salt marsh and upland, but also in vast mats in varied stages of plant succession throughout the interior of the island. High marsh vegetation chiefly reached into some interior portions of the island and is shown as dense grassland on the vegetation map for this island.

58. Vegetation on A35 was characterized by an early successional stage, but portions of the island also exhibited vegetation indicative of mid and late successional stages. The interior of the island was dominated by common reed which grew densely in some places. Frequently live and dead bayberry and groundsel were found among the reed, with a mixture of live and dead marsh elder (*Iva frutescens*), also mixed with common reed, wild morning glory (*Convolvulus sepium*), and orach (*Atriplex patula*).

59. Large areas of the island had exposed drift material. It ranged from scattered bare stems and debris to about 50 percent of low herbs and grasses. The earliest invaders of the drift were common reed and sea rocket (*Cakile edentula*). The later stages were vegetated by goldenrod (*Solidago tenuifolia*), seaside goldenrod, wild morning glory, poor-man's pepper (*Lepidium virginicum*), and wild bean (*Strophostyles helvola*) as well as sea rocket and common reed. Poison ivy (*Rhus radicans*) and bayberry were also present and represented transition into the mid seral stage. These successional drift areas were mapped as dense grassland on the vegetation map (Figure 7) unless characterized by a good growth of reed in which case they were included with adjacent reed or reed-shrub communities. The extent of the drift can be seen on a drift overlay of the island (Figure 6).

60. East Carvel Island supported a colony of common terns (*Sterna hirundo*) (160 pairs), black skimmers (*Rynchops niger*) (7 pairs), and one pair of herring gulls (*Larus argentatus*) in June 1977. The birds were distributed over most of the exterior portions of the island.

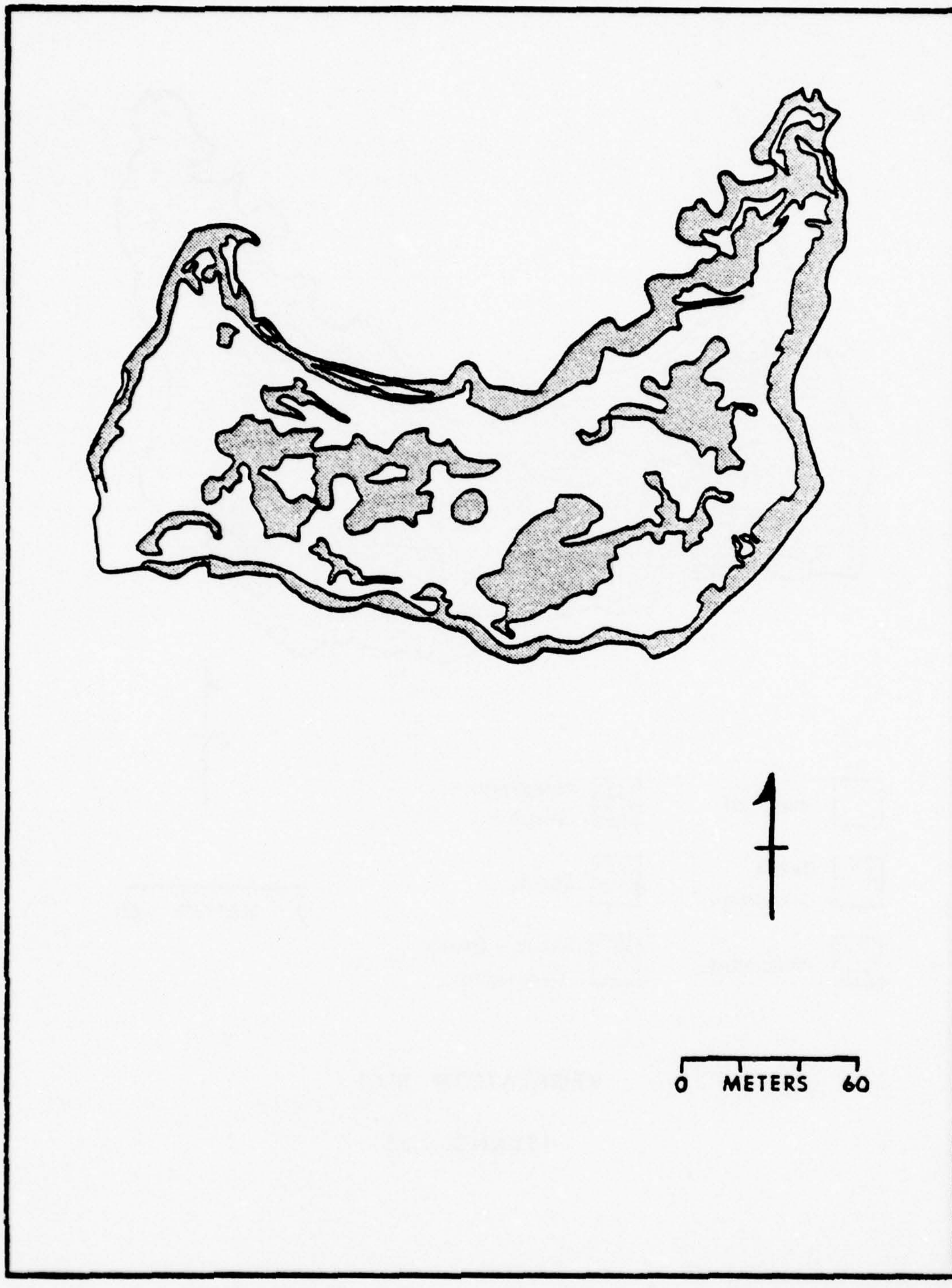

Figure 6. Drift map of Study Island A35

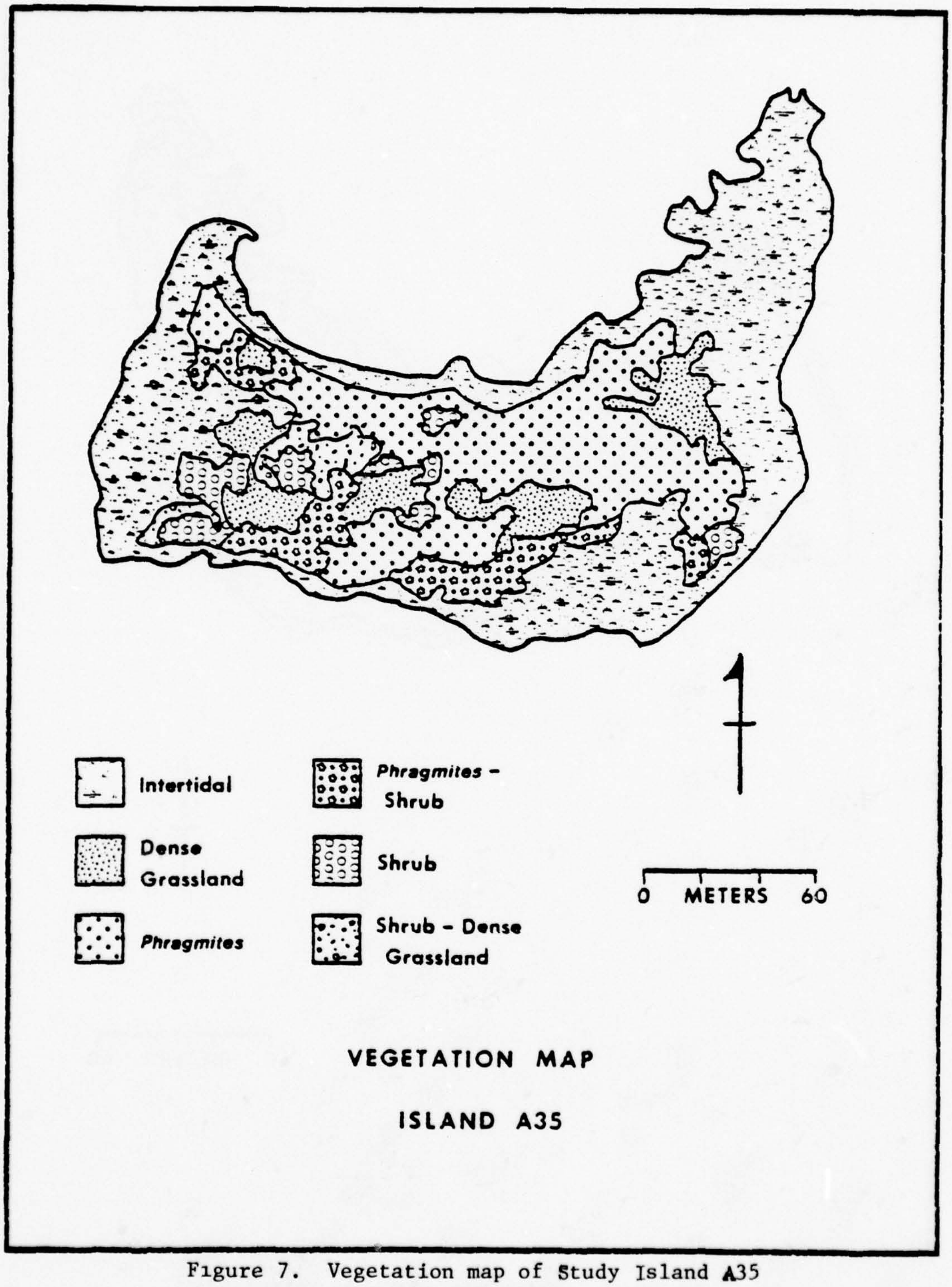

Figure 7. Vegetation map of Study Island A35

(Figure 8). The nearest colony with the same species present was only 0.24 km away on West Carvel Island. In 1976, A35 had only a small common tern colony (45 pairs) nesting on it (Burger and Lesser 1976).

Study Island A43a, Ham Island

61. Island A43a (Ham Island) is an irregularly shaped, undiked dredged material island that probably was a natural island originally, but later had dredged material deposited upon it. Located in Ocean County at 39° 36' N and 74°13' W, it is 11.3 km north of Beach Haven Inlet and 0.28 km from the New Jersey Intracoastal Waterway. The southeastern tip of the island had a dredged material deposit of 1.13 ha. The entire island is almost 8.1 ha. The tidal range at Ham Island is 0.67 m. It is a low, fairly flat island with elevation under 1.0 m. Most of the island is salt marsh with drift mats concentrated near the daily high tide mark. The dredged material area has only a slight elevation and is covered with tall vegetation.

62. The vegetation is considered to be of an early seral stage (Appendix B), though mid seral stage vegetation is also present. A dense growth of common reed dominates the dredged material area. Portions of it are mixed with abundant 1.0 to 1.5-m high bayberry and groundsel. High marsh vegetation extended into the interior of the common reed associations as indicated in Figure 9.

63. Ham Island has supported nesting common terns in the past (Appendix A), but more recently a common tern colony was located only 0.16 km away on a small salt marsh island lying between Ham Island and the barrier beach island east of it, indicated in Figure C2 as colony A43a, Little Ham Island. Common terns nested on Little Ham Island in 1976 (Burger and Lesser 1976, Kane and Farrar 1976), and in 1977 its numbers had increased to 60 pairs. Eight pairs of black skimmers were also found nesting. This small salt marsh island has been referred to as Ham Island by past workers (Burger and Lesser 1976, Kane and Farrar 1976), so earlier references to Ham Island as a nesting site (Frohling 1965) might refer to this site rather than to Island A43a. Common terns utilized the island edges for loafing in 1977.

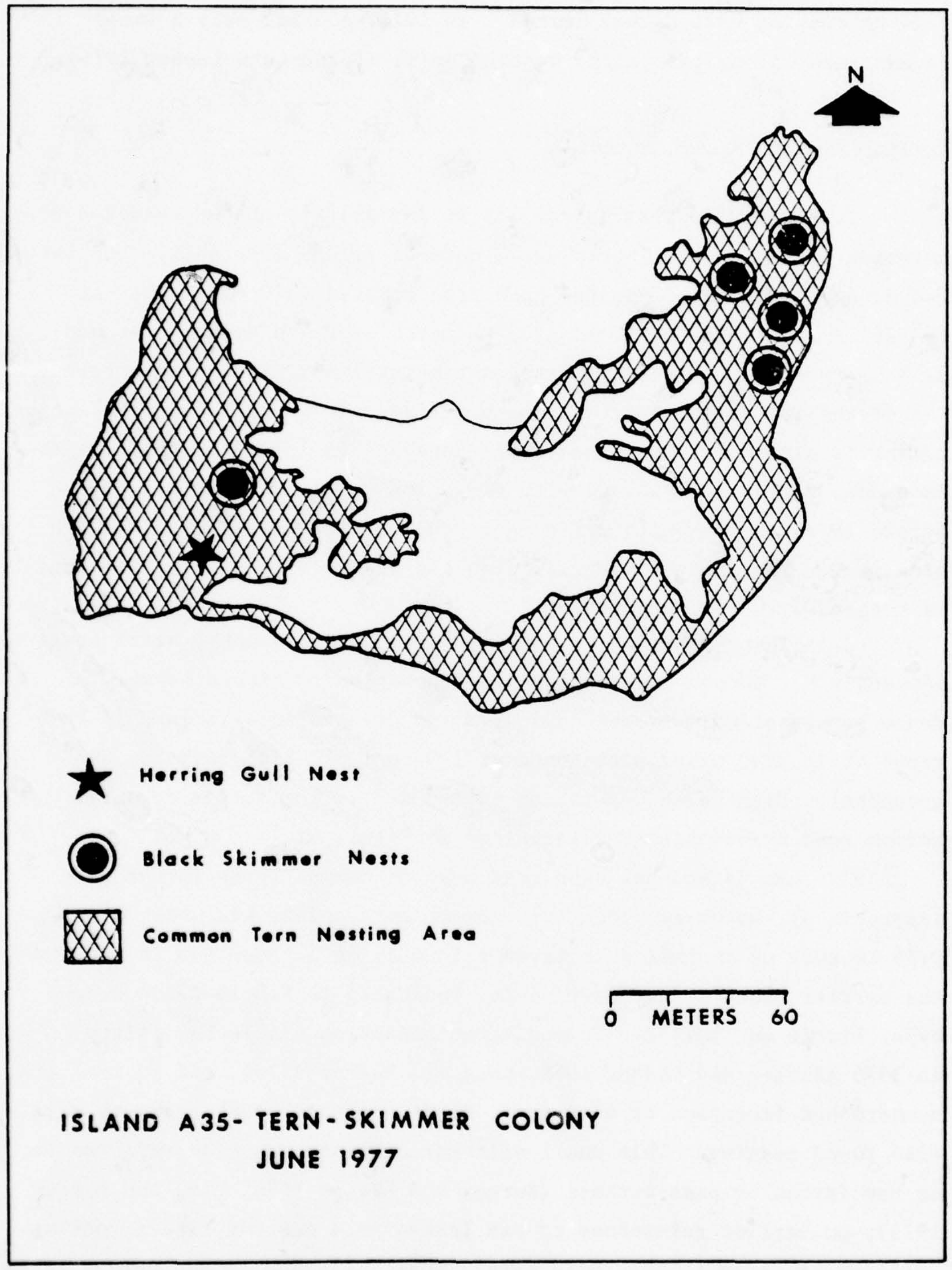

Figure 8. Map of common tern-black skimmer colony on Study Island A35

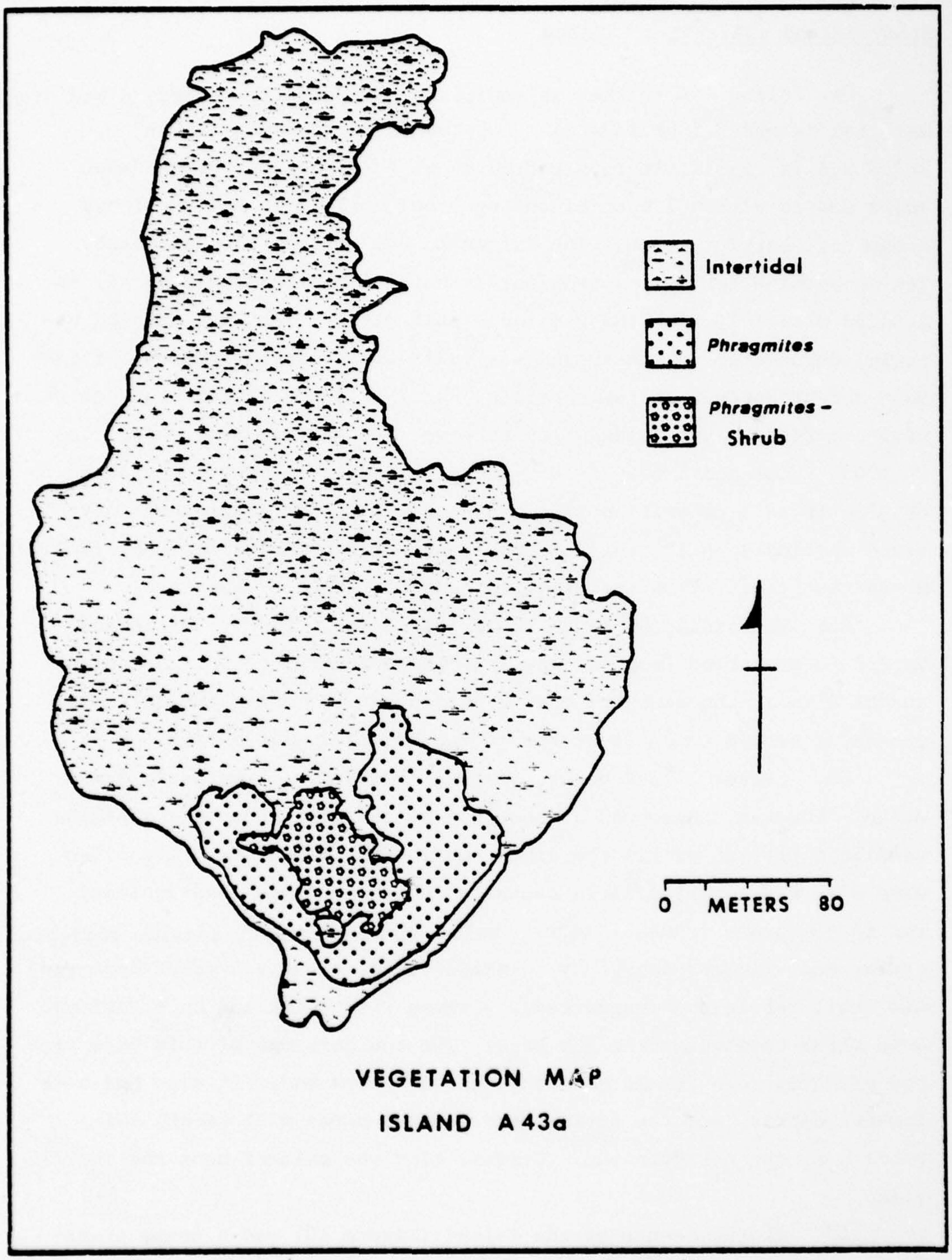

Figure 9. Vegetation map of Study Island A43a

Study Island 45A. Parker Island

64. Island 45A (Parker Island) is an irregularly shaped, diked dredged material island 5.5 ha in size. Located in Ocean County at 39^{o} 34' N and 74^{o} 15' W, it is situated about 8 km north of Beach Haven Inlet and is within 1.8 km of cottages and marinas on the developed oceanfront barrier beach. The island is 0.1 km from the New Jersey Intracoastal Waterway. Approximately half of the island (2.55 ha) is dredged material, with the remainder salt marsh. The last dredged material deposition on the island was in 1976. The actual extent of the most recent deposition is uncertain, but it did not include the center of the island. This island also received dredged material deposition in 1963, 1966, and 1967. Although the Philadelphia District planned to utilize it as a deposition site again in 1977, when least terns were found nesting upon it, they did not (personal communication, May 1977, M. Bartlett, U.S. Fish and Wildlife Service, Absecon, NJ).

65. The tidal range at Parker Island was 0.67 m. The island varied in elevation from sea level at the northern end to 1.5 m high on the dike at the southern end. The deposition inside the dike was gradually sloped to a slight summit approximately 1.0 m high.

66. Parker Island vegetation was indicative of an early seral stage. However, there was a short row of Austrian pine (*Pinus nigra*) seedlings present within the diked portion of the island. The 1.0-m wide dike had a varied flora dominated by common reed and included red fescue grass (*Festuca rubra*), saltmeadow cordgrass, seaside goldenrod, orach, and wild morning glory. Inside the dike was a band of bare sand and shell (whole and fragmented). Common reed culms and an occasional dead shrub protruded from the sand. The southern end of this bare area had slightly more common reed than the northern end. It also had more lumber debris, and the surface had several areas with smooth contours at the northern end. Cracked clay was evident near the outfall pipe.

67. At the center of the island (Figure 10) was a dense grassland dominated by saltmeadow cordgrass. Seaside goldenrod, Canada

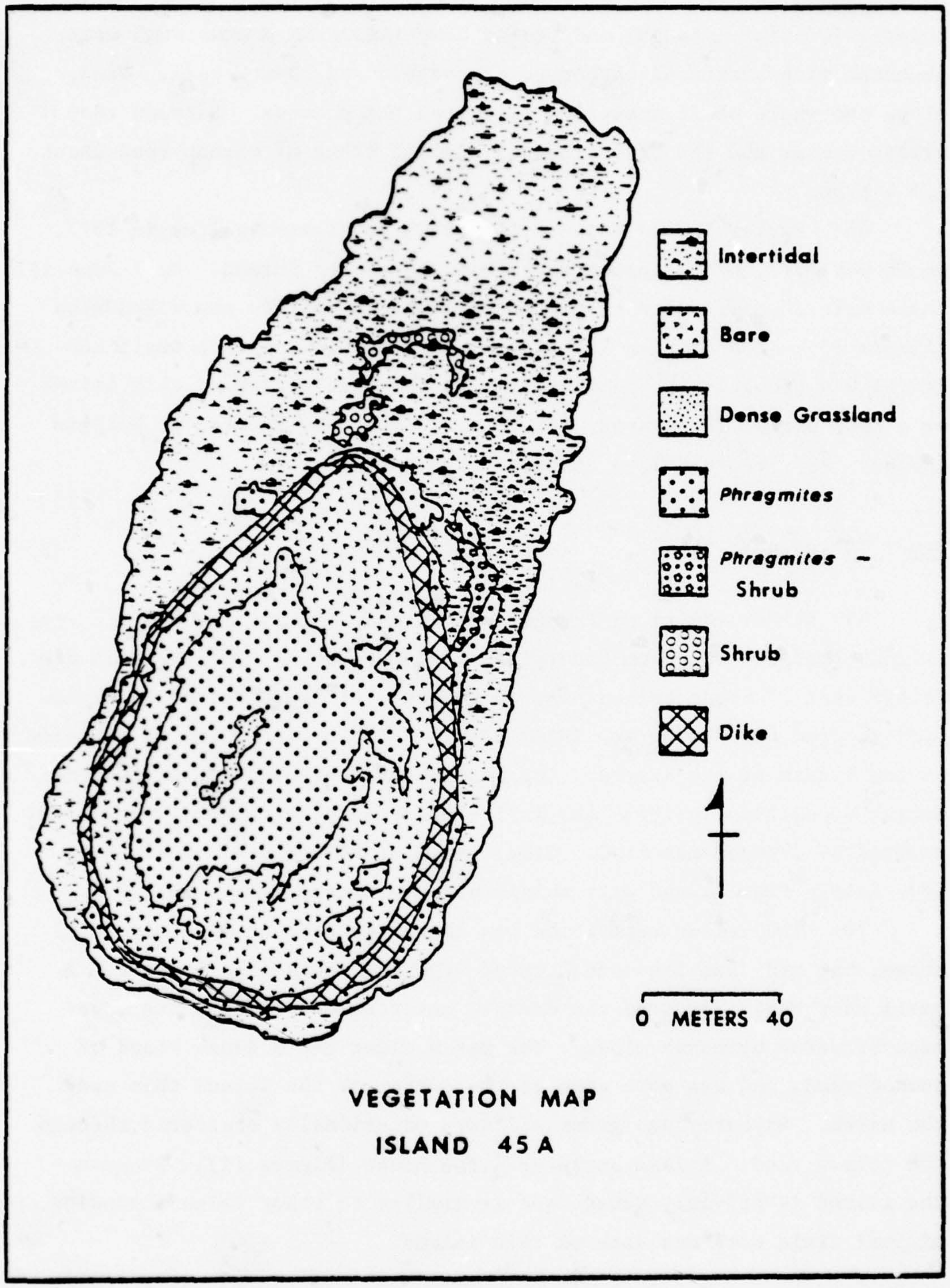

Figure 10. Vegetation map of Study Island 45A

thistle (*Cirsium arvense*), and Indian hemp (*Apocynum cannabinum*) were abundant with scattered bayberry, groundsel, and common reed. Sand, clay, and whole shell substrate supported the grasses. Between the grassy center and the bare area was a solid stand of common reed about 1.5 m high.

68. Parker Island supported a small least tern colony in 1977. On 13 May 1977, 6 to 7 pairs were observed on the island. By 7 June 1977 there were 20 pairs with nests and eggs present within the diked area (Figure 11). The dredged material of bare sand mixed with shell and gravel was probably the major factor in their selection of this island as a nest site. The nearest least tern colony was located at Holgate (colony 28, Figure C2), a distance of 6.8 km.

Study Island 45B

69. Island 45B is an irregularly shaped, undiked dredged material island. Located in Ocean County at 39° 34' N and 74° 15' W, it is directly west of Study Island 45A, 8 km north of Beach Haven Inlet, and 0.12 km from the New Jersey Intracoastal Waterway. A house is situated on the middle of the island. The island was last used for dredged material deposition in 1963 and is 1.6 ha in size, with about 1 ha of it covered by dredged material. Tidal range at 45B is 0.67 m. It is a low, fairly flat island with an elevation probably less than 1.0 m.

70. The island vegetation was characteristic of an early seral stage, but mid and late seral stage vegetation was also present. A small salt marsh bordered the dredged material deposition, its upper edge bordered by marsh elder. The marsh elder met a dense stand of common reed, and was more open at the center of the island than near the marsh. Bayberry and groundsel were occasionally scattered through the common reed. A lawn surrounded the house (Figure 12). Because the island is privatly owned, and is similar to other islands studied, minimal field work was done on this island.

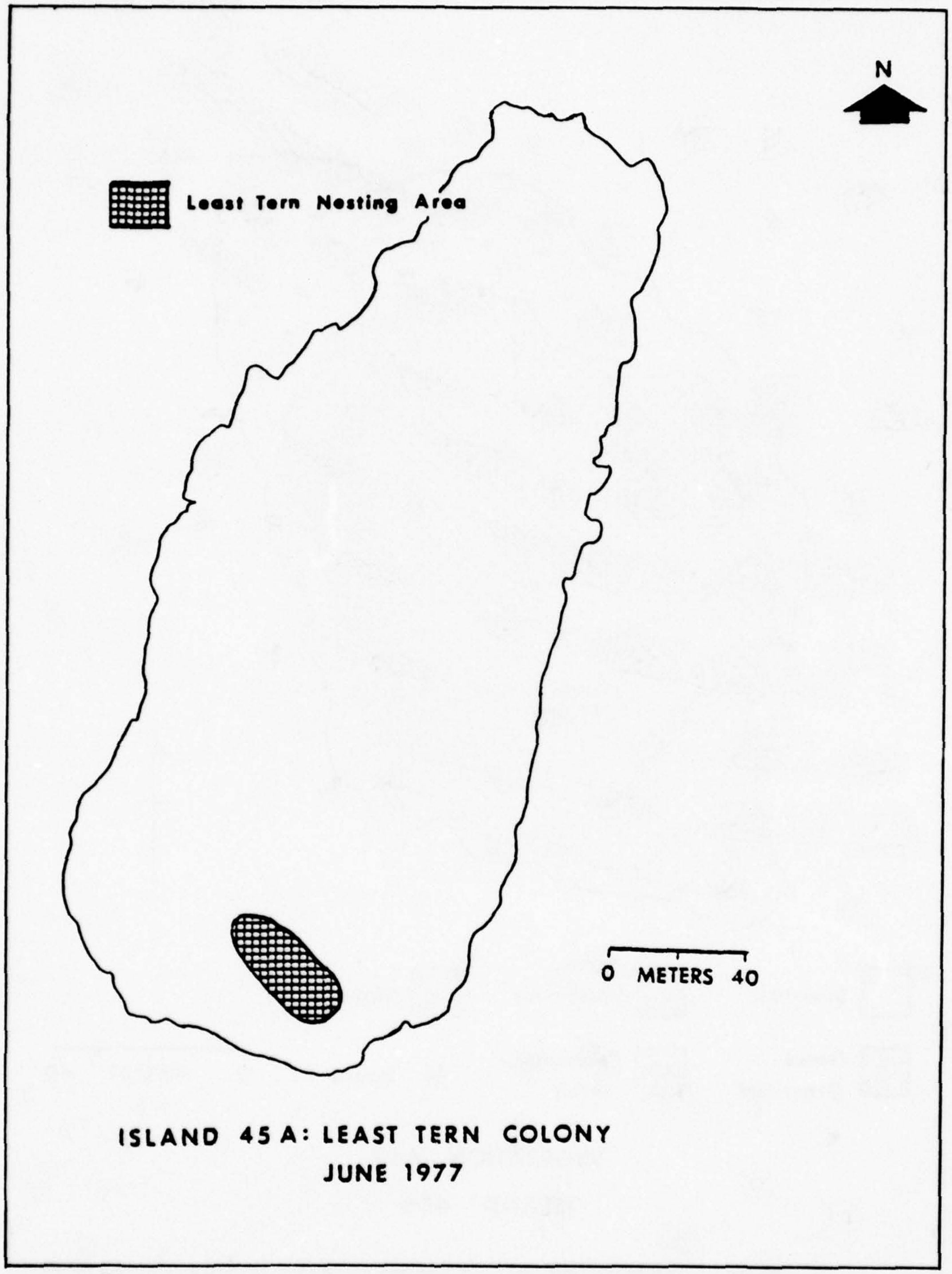

Figure 11. Map of least tern colony on Study Island 45A

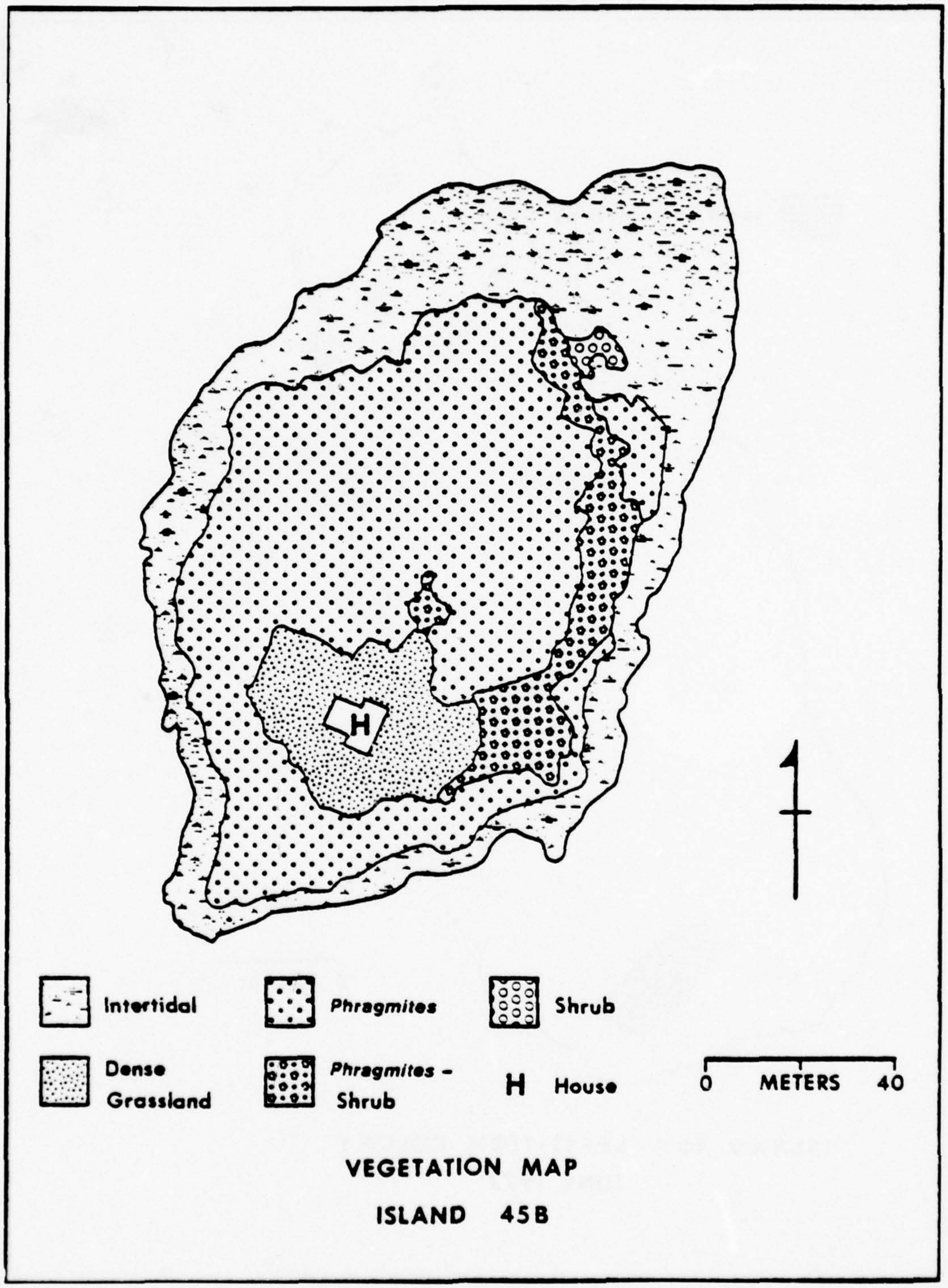

Figure 12. Vegetation map of Study Island 45B

Study Island X27, Goosebar Sedge

71. Island X27 (Goosebar Sedge) is a low, irregularly shaped, undiked dredged material island. Located in Ocean County at 39° 32' N and 74° 17' W, it is 0.40 km from the New Jersey Intracoastal Waterway and 3.2 km northwest of Beach Haven Inlet. The island is 13.2 ha in size and is mostly salt marsh. At low tide, extensive tidal flats surround the island. The dredged material deposition measures only 0.7 ha and is irregularly elongate on the northeastern side of the island.

72. Stone (1937) refers to the establishment of a black skimmer colony in 1930 on a "sand island created by dredging in the bay west of Beach Haven" that he calls "Goosebar Island," and that is probably Goosebar Sedge. In 1931, the black skimmers were again nesting on the island (Appendix A). This dredged material island has probably not been deposited upon recently, at least since 1969 (F. Lesser, 1977, personal communication). It is not known if there was any dredged material deposition upon the island between 1931 and 1969.

73. Elevation of the island was low, with a central ridge rising to about 1.0 to 1.5 m. The tidal range on the island was 0.79 m, and the presence of drift on the ridge indicated some storm tide inundation. The deposit's central ridge was composed of sand and shell and was exposed on some parts. Tidal flats were 1.75 ha in extent and were present at the edges of the adjacent marsh. The dredged material island study area consisted of two connected areas. The southern one was elongate on a south-to-north axis and was chiefly dense grassland on the higher portions, with a shrub thicket between it and the salt marsh. The second area was a low rise on the northern end of the upland portion of the island. It was chiefly dense grassland, though rather sparse on top. A border of marsh elder occurred at many places where the upland met the salt marsh.

74. Island X27 was characterized by late seral stage vegetation (Appendix B) but early and mid seral stage vegetation was also present (Figure 13). The grassland on the south central portion was dominated

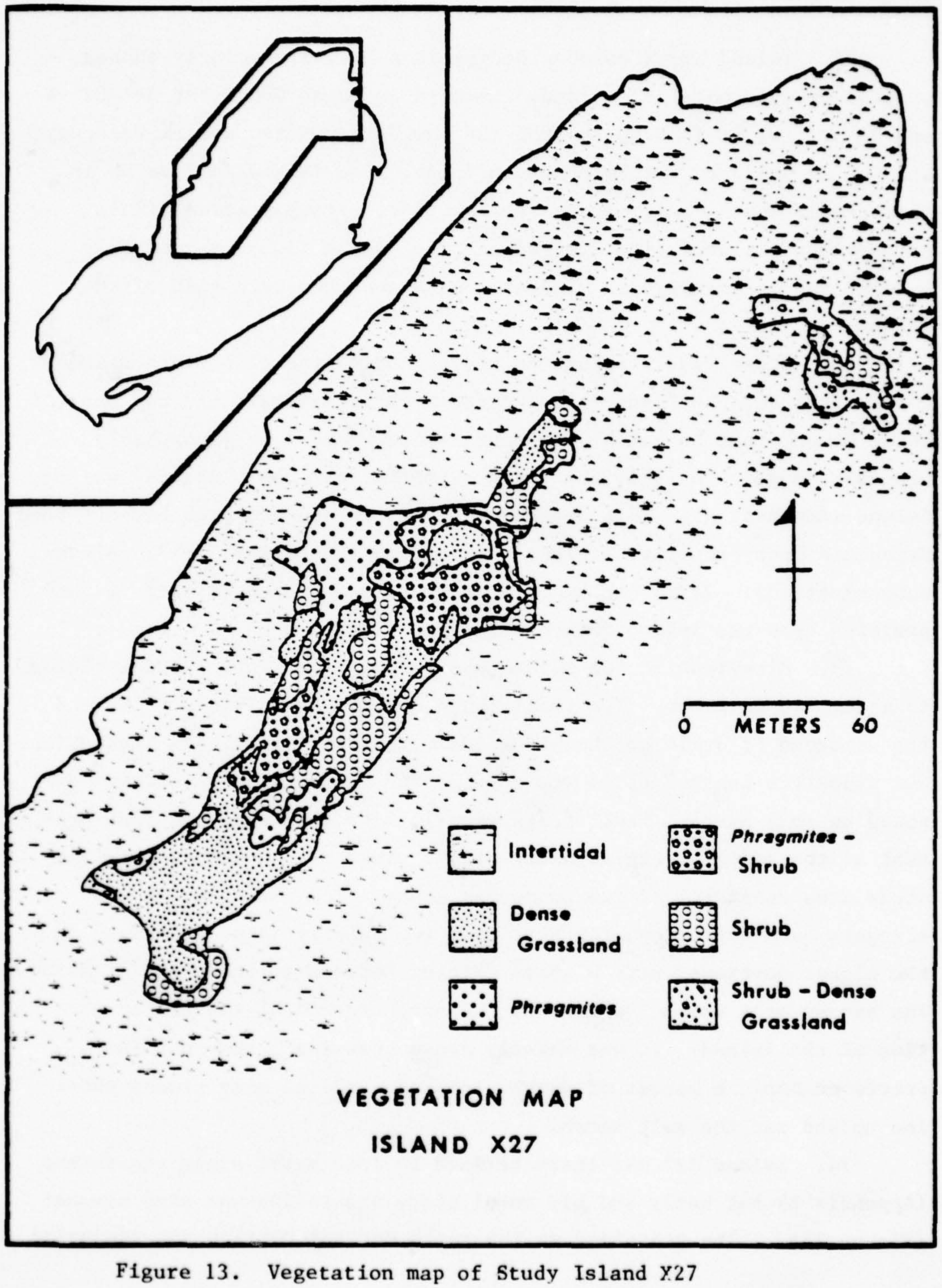

Figure 13. Vegetation map of Study Island X27

by American beachgrass, poor-man's pepper, and yarrow (*Achillea millefolium*). On the western side of the grassland was a shrub thicket with 2.0 to 4.0-m high groundsel and shorter marsh elder with abundant wild lettuce (*Lactuca biennis*) beneath. The shrub thicket on the east was dominated by groundsel and poison ivy, with wild lettuce and yarrow in the herb layer. Further to the south, patches of marsh elder met the dense grassland areas. On the northernmost end of the deposit area, the grassland was composed of poor-man's pepper, yarrow, American beach-grass, Canada thistle, seaside goldenrod, and beach-pea (*Lathyrus japonicus*). Marsh elder and groundsel separated the grassland from the high marsh.

75. Goosebar Sedge supported a mixed species heronry, as well as a herring gull colony and five pairs of great black-backed gulls (*Larus marinus*). The island had supported a heronry and herring gulls in 1976 (Kane and Farrar 1976). The birds were already on site during the May survey and all species had young, ranging from newly hatched to running, by the June survey. The herons were nesting in the common reed, reed-shrub, and shrub communities (Appendix B), but their nests were mostly in bayberry about 1.5 m high, many of which were dead or not fully leafed (Figure 14). The herring and great black-backed gulls nested in the dense grassland communities surrounding the base and periphery of the heronry. Many nests were at the base of marsh elder and groundsel shrubs less than 1.0 m high.

76. The nearest heron colony to Goosebar Sedge was located on Barrel Island (colony X47 on Figure C2), only 0.4 km away. The closest herring gull-great black-backed gull colony was located approximately 1.7 km away on Middle Island (colony 25, Figure C2).

Study Island 51B, Shooting Thorofare

77. Island 51B (Shooting Thorofare) is an irregularly shaped, rectangular, undiked dredged material island. Located in Ocean County at 39° 31' N and 74° 18' W, it is in the Tuckerton marshes directly opposite Beach Haven Inlet and 0.3 km from the New Jersey Intracoastal

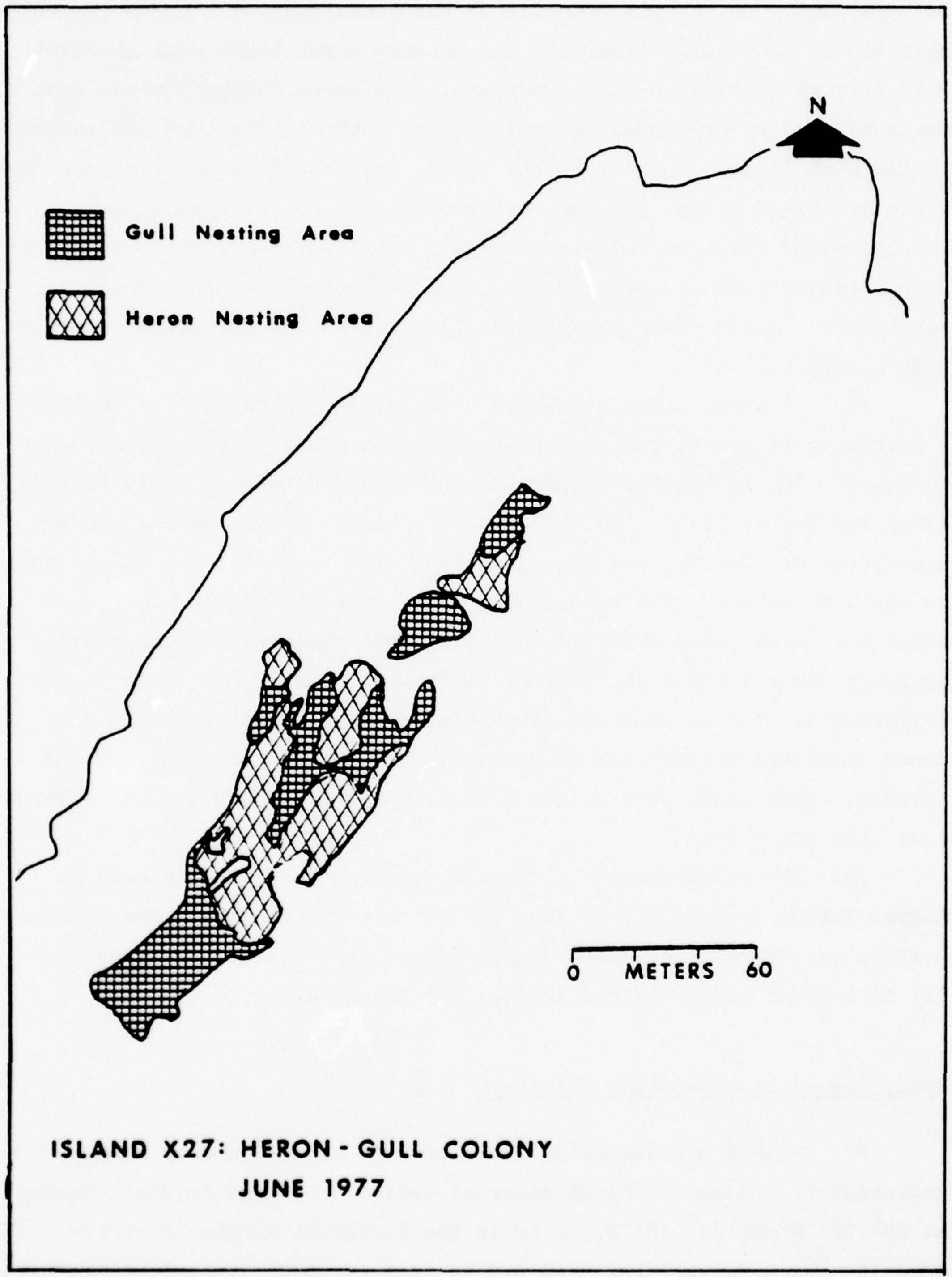

Figure 14. Map of heron-gull colonies on Study Island X27

Waterway. The island size was estimated to be 17 ha, with a dredged material deposit 1.8 ha in size. The dredged material deposit on Island 51B was placed in 1965 upon a large area of salt marsh, which extends about 7.2 km from Tuckerton. The dredged material deposition was basically rectangular in shape, with a cutoff pattern to the arching vegetation zone, suggesting that the deposit was subject to erosion. Sides of the surrounding salt marsh were badly eroded by wave action.

78. Vegetation was characteristic of an early seral stage, though mid seral stage vegetation was also present. Much of the marsh surface was non-vegetated peat and salt panne. Drift material left by storm tides was found partway up the deposit dome. On the dome (Figure 15) seaside goldenrod, tumble grass, and small fleabane (*Erigeron pusillus*) were the most abundant plants. The base of the dome was predominantly of American beachgrass. On the south this gradually descended to a mixture of common reed that was 1.0 to 1.5 m tall and growing above an American beachgrass layer. Bayberry shrubs were scattered throughout, and a large area of drift was beneath some of the sparser reed areas. The northern side had a similar mixture of reed, low grasses, and herbs but with abundant bayberry and groundsel scattered throughout. The western side had a high marsh with a mixture of common reed on the upper edge. The marsh was frequently bordered by marsh elder, common reed, and groundsel.

79. While Island 51B did not support any nesting colonies of seabirds or wading birds in 1977, it may have in the past. Common terns and black skimmers nesting on the barrier beach at nearby Holgate were forced to leave there because of rat predation. About a year after Island 51B received dredged material deposition (1965) these species were believed to be using this site (personal communication, October 1977, W. Shoemaker and R. Mangold, Department of Environmental Protection, Trenton, NJ) for nesting. The birds have since returned to Holgate to nest (Appendix A).

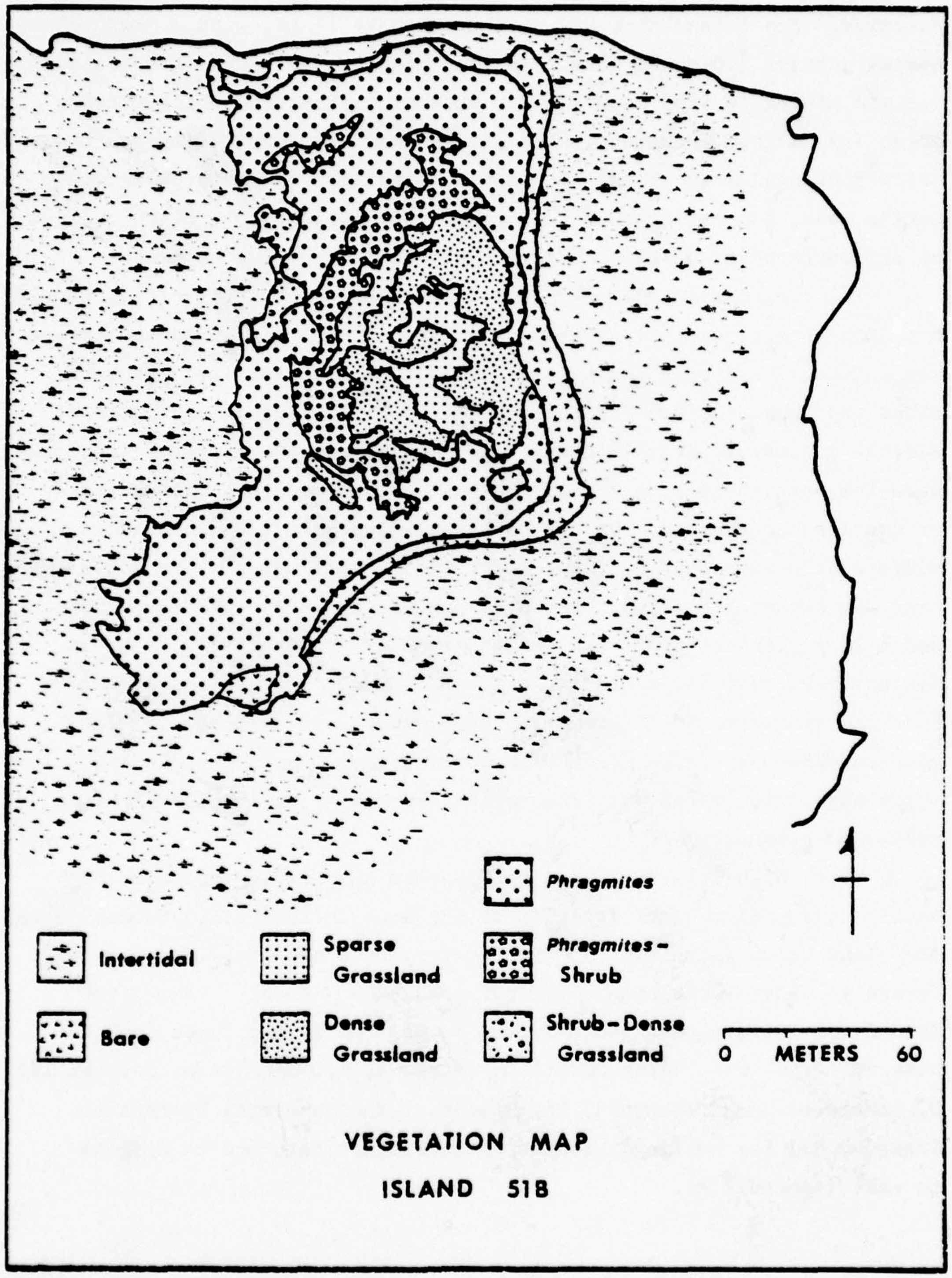

Figure 15. Vegetation map of Study Island 51B

Study Island A61c, Little Heron Island

80. Island A61c (Little Heron Island) is a circular, undiked dredged material island. Located in Atlantic County at 39^{o} 24' N and 74^{o} 26' W, it is about 5.2 km northwest of Absecon Inlet and 0.12 km from the New Jersey Intracoastal Waterway. Island size is approximately 5.5 ha with a 3.5 ha dredged material deposit. The date of the last dredged material deposition is unknown, but was probably prior to 1969. Tidal range on the island is 1.03 m and the island is surrounded by extensive salt marsh. Island elevation is approximately 1.0 to 1.5 m.

81. Little Heron Island was characterized by early seral stage vegetation and was dominated by a large stand of 2.4-m high common reed. Mid and late seral vegetation were also present, and live and dead groundsel were scattered throughout the common reed. Seaside goldenrod and poor-man's pepper were common in places beneath the reed. On the eastern side of the dredged material was an arc which had a lower vegetation cover. By aerial view it appeared to be a ridge vegetated by grasses, reed, and scattered bayberry (Figure 16). Some of the outer parts of the dredged material had 0.5 to 3.6-m high shrub thickets, composed mostly of bayberry, groundsel, and marsh elder, with an abundance of orach and common reed.

82. On the western side of the island the vegetation was more marsh dominated. The upper part of the salt marsh was bordered by marsh elder with black grass (*Juncus gerardi*), red fescue grass, and saltgrass (*Distichlis spicata*) carpeting most of the ground. Drift mats were also present in this area. Between the marsh elder and the common reed was an arc of essentially bare salt panne surrounded by high marsh, composed chiefly of saltgrass and black grass. In one location there was a ridge about 0.5 m above the marsh surface vegetated by a 3.6-m high shrub thicket and dominated by bayberry and marsh elder with scattered reed. The herb layer consisted of orach, saltgrass, saltmeadow cordgrass, and pigweed (*Chenopodium album*).

83. Little Heron Island supported one of the largest mixed species heronries and herring gull colonies in New Jersey in 1977. The island

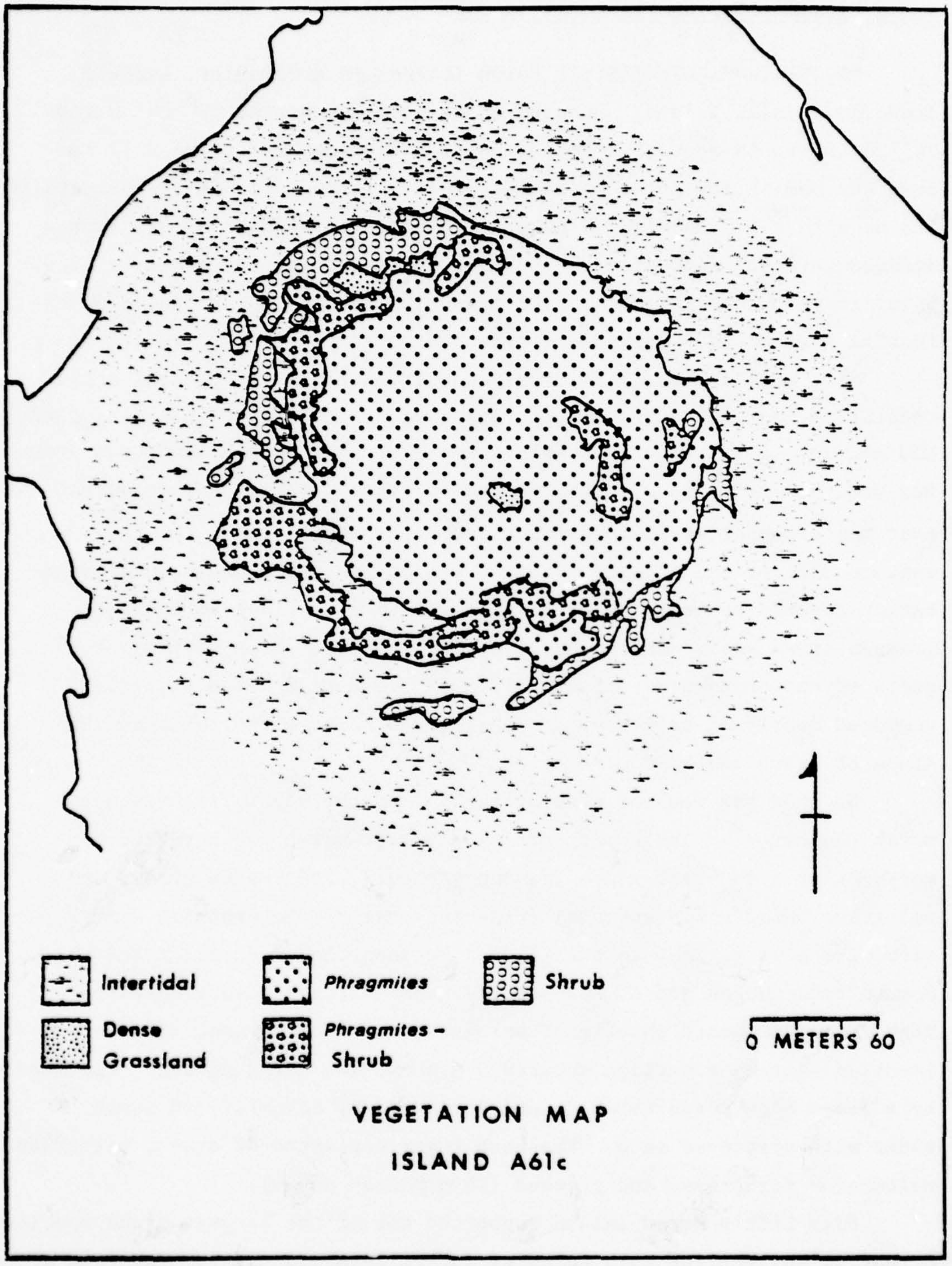

Figure 16. Vegetation map of Study Island A61c

has been the site of a heronry since at least 1959 (Adams and Miller 1975) and of a herring gull colony since at least 1974 (Burger 1977b). All of the herons nesting in New Jersey except great blue herons (*Ardea herodias*) and green herons (*Butorides striatus*) were found in this colony. However, yellow-crowned night herons (*Nyctanassa violacea*) present in May, were not observed in June at the colony site. During the May survey all species had eggs, and by June 7 young were present in and out of their nests. The herons occupied most of the upland portions of the study island and were found in common reed and common reed-shrub vegetation communities (Figure 17). Although they nested in the reed, many nests were placed in live and dead bayberry and groundsel scattered through the reed.

84. The gull colony was located on the periphery of the heronry, with the gulls nesting in a wide variety of vegetation communities (Figure 17): dense grassland, common reed, common reed-shrub, shrub, and intertidal. While most nests seemed to be at the base of low marsh elder and groundsel shrubs, a preferred site in more crowded colonies (Burger 1977a), many were also in the wetter areas of the intertidal zones and on bare sand. There were six pairs of great black-backed gulls scattered among the herring gulls. They were more advanced than the herring gulls since only young and no nests were found in June. The nearest heronry and gull colony to Little Heron Island was only 1.2 km north at Islajo (colony A61b, Figure C2), another dredged material island very similar to A61c and adjacent to the New Jersey Intracoastal Waterway.

Study Island A59a, Perch Cove Point (Big Shad)

85. Island A59a (Perch Cove Point) is also called Big Shad. It is a circular, undiked, dredged material island within the boundaries of Brigantine National Wildlife Refuge. Located in Atlantic County at 39^{o} 28' N and 74^{o} 24' W, it is west of Brigantine Inlet and adjacent to the New Jersey Intracoastal Waterway. The dredged material portion of the island is nearly 2.4 ha in size and at the tip of a salt marsh

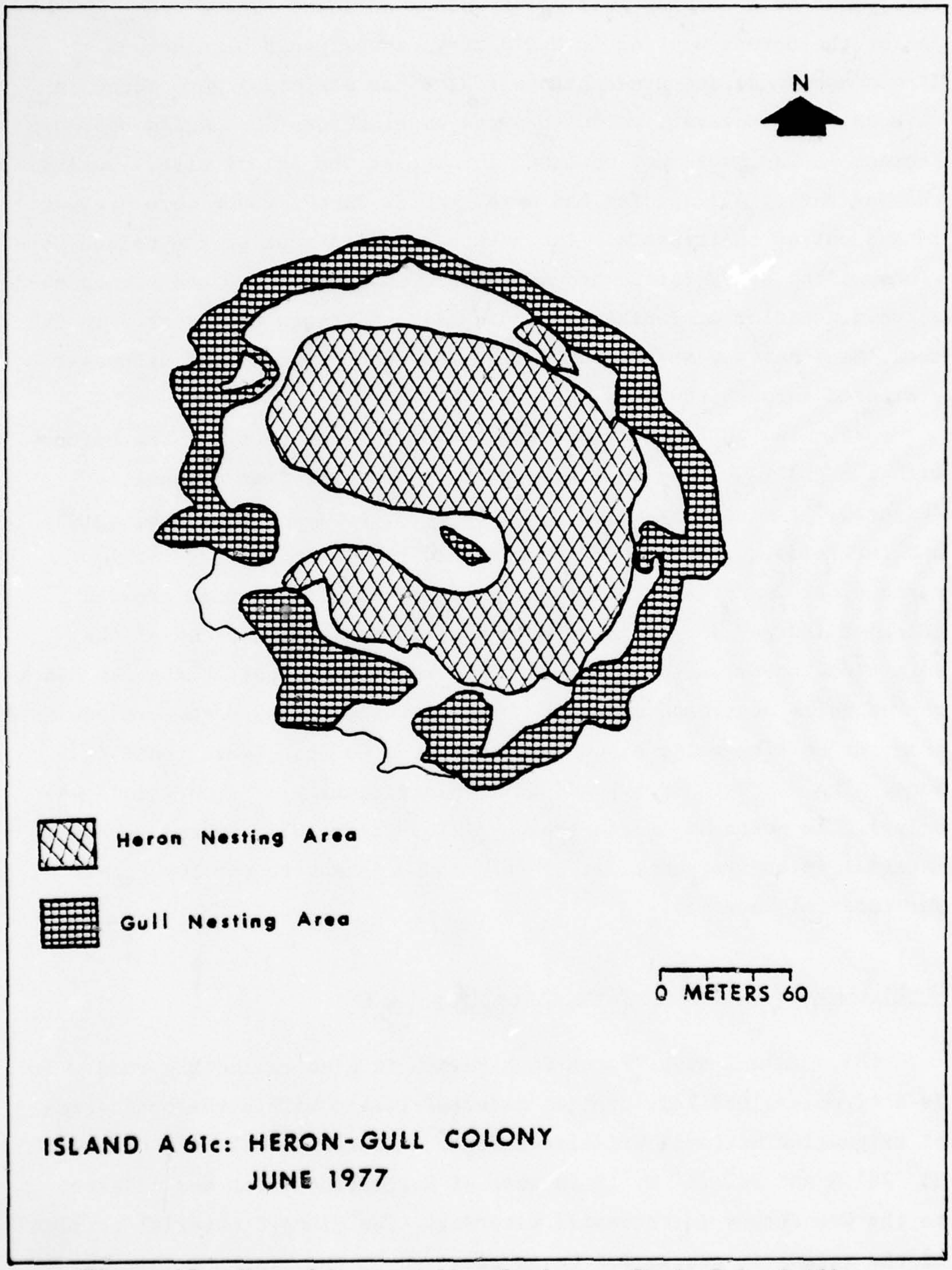

Figure 17. Map of heron-gull colonies on Study Island A61c

abutting Perch Cove. The tidal range at the site is 1.03 m and the island's elevation is estimated to be not more than 1.0 m. Tidal flats (1.2 ha) are adjacent to the dredged material deposit. Despite the presence of early and late seral stage vegetation, the study island was dominated by mid seral stage vegetation communities (Appendix B).

86. The perimeter of the dredged material deposit was covered by a large bare salt flat beyond which there was an expanse of salt marsh. A narrow band of salt marsh also surrounded the upland vegetation. The high marsh vegetation mixed with marsh elder and gradually ascended to a mixture of 2.0-to 4.0-m-high common reed, bayberry, groundsel, and marsh elder. Common reed dominated this association on most of the island. On the eastern side, and at one place on the west side, 4.0-to 6.0-m high shrubs dominated the reed. Several 1.8-to 3.6-m-high shrub thickets were located throughout the island. The shrub thickets were dominated by bayberry and groundsel, though poison ivy and common reed were also present. A few red cedar (*Juniperus virginiana*) trees, 3.0 to 4.6 m high, also grew in the thickets (Figure 18).

87. Perch Cove was selected as a vegetation study island, but it had herons nesting or attempting to nest on it in May 1977. Although not previously recorded as a seabird or wading bird nesting colony site, 20 pairs of black-crowned night herons (*Nycticorax nycticorax*) were nesting. On 3 June, a few black-crowned night herons were still present along with a pair of yellow-crowned night herons (Kane and Farrar 1977). By June and thereafter there was no sign of the birds. It is possible that their young had fledged by this time (Appendix A), or that the birds had deserted the island after predation or human disturbance. The part of the island on which the birds were found was an area of mixed shrubs and common reed with abundant, very high poison ivy intermixed with the other species.

Study Island 85dmi, Weakfish Creek

88. Island 85dmi (Weakfish Creek) is a circular, undiked dredged material island. Located in Cape May County at 39° 13' N and 74° 39' W,

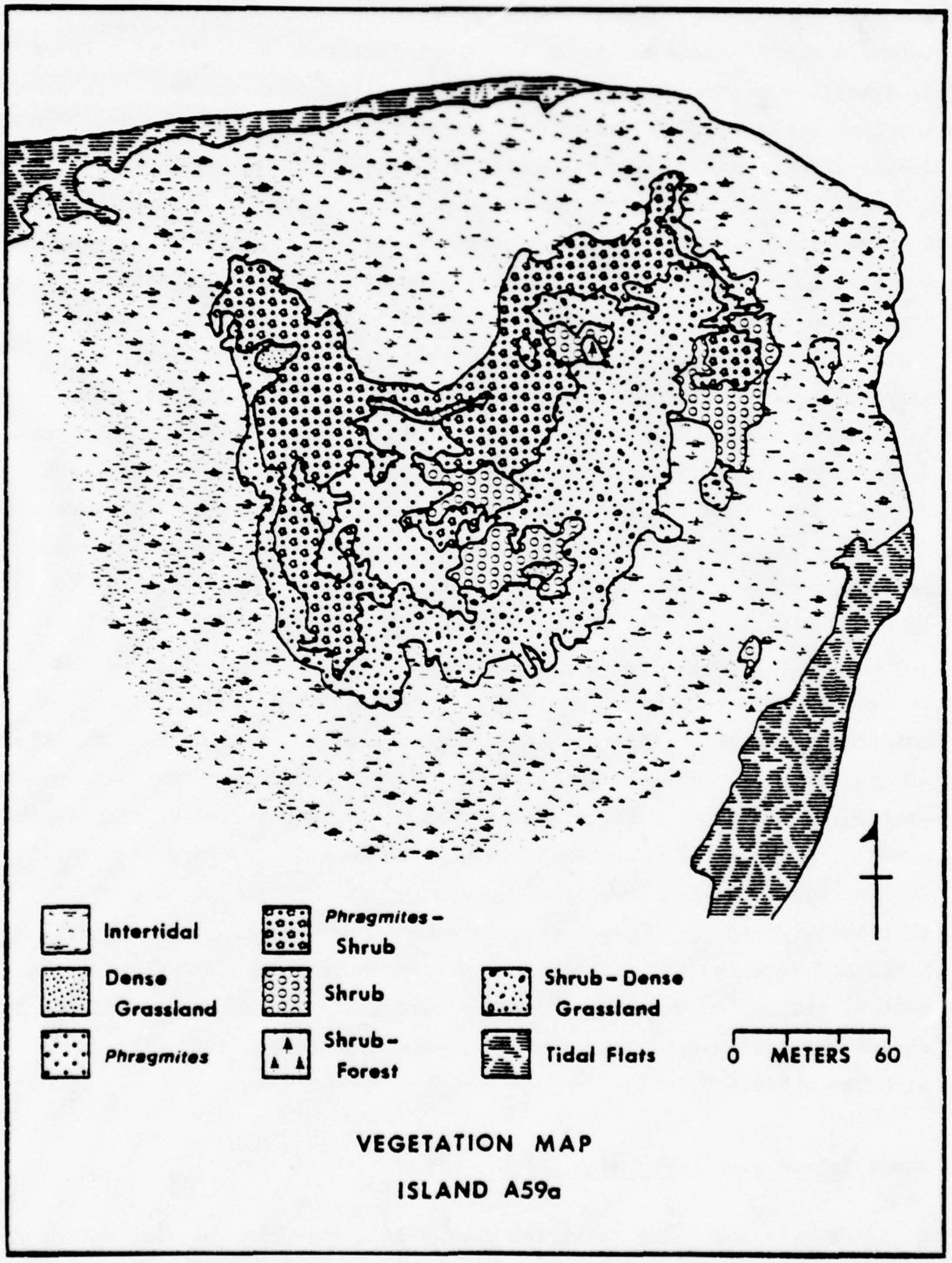

Figure 18. Vegetation map of Study Island A59a

it is northwest of Corson's Inlet, south of the junction of Beach Creek and Weakfish Creek, and adjacent to the New Jersey Intracoastal Waterway. It is a salt marsh area which had dredged material deposited upon it in 1966. The dredged material deposit area was approximately 2.4 ha on an island that was 3 ha in size and surrounded by extensive salt marsh. Houses were nearby on the barrier beach. Tidal range on this island is 1.1 m. It is a fairly low, flat island with elevation estimated at less than 1.0 m. Vegetation was characteristic of a late seral stage but early and mid seral stage vegetation was also present.

89. Most of the dredged material deposit area was vegetated by shrubs and common reed. A wide belt of marsh elder with a herb layer of saltmeadow cordgrass, red fescue grass, and several other plants including some halophytes was present. The northwestern tip of the dredged material was dominated by common reed. In many places shrubs mingled with the reed. These included 2.0 to 4.0-m high bayberry, poison ivy, and a small amount of elderberry (*Sambucus canadensis*), groundsel, and red cedar. On the marsh side, marsh elder was associated with common reed. Here black grass and saltmeadow cordgrass formed the ground cover. There were some areas in which the shrubs dominated the reed, and in others the reverse was true. Besides the reed-shrub associations, the shrub thicket itself was very important. This included bayberry, groundsel, marsh elder, occasional red cedar, and some 1.0 to 2.0-m high reed. (Figure 19).

90. Weakfish Creek supported a much larger heronry in May 1977 than it did in either June 1976 (Appendix A) or June 1977. In May 1977 there were 75 snowy egrets (*Egretta thula*), 45 black-crowned night herons and two cattle egrets (*Bulbucus ibis*) nesting on the island. By 6 June 1977, no cattle egrets were found but glossy ibises (*Pledagis falcinellus*) were present. The herons were nesting in the shrub community with most nests in bayberry as high as 4.5 m (Figure 20). The nearest heronry to Island 85dmi was at Cowpens Island (colony A80a, Figure C2), a distance of about 8.85 km.

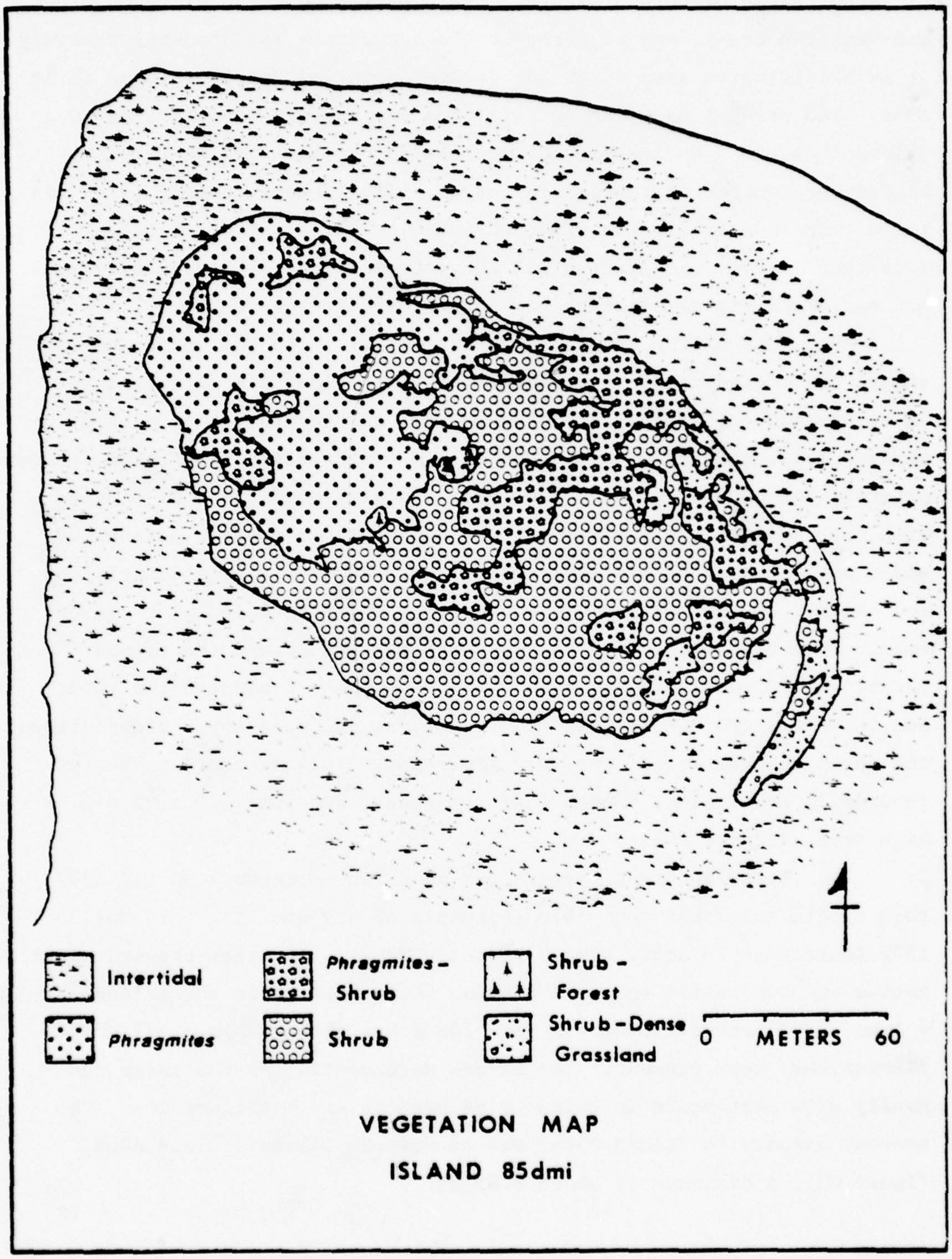

Figure 19. Vegetation map of Study Island 85dmi

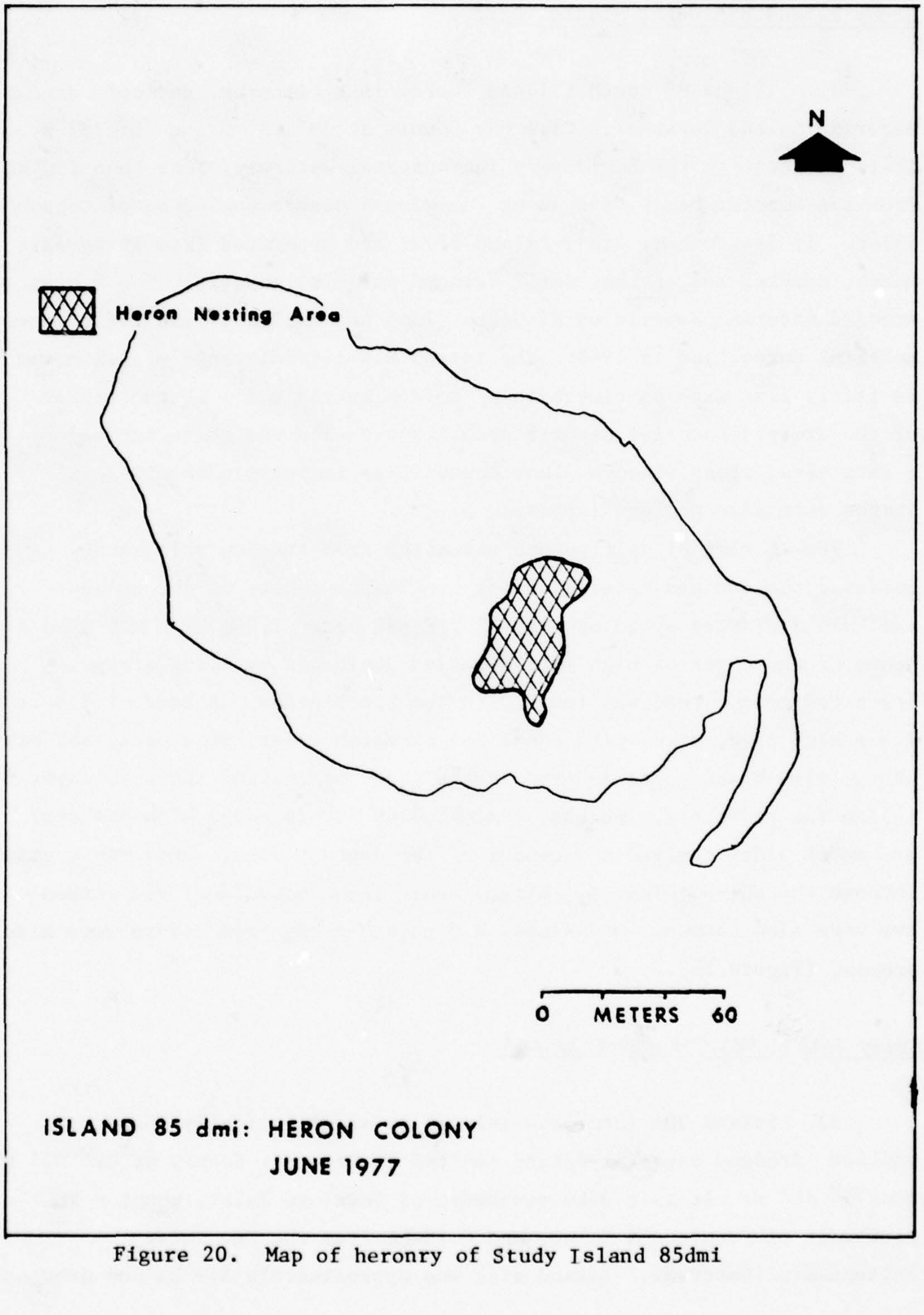

Figure 20. Map of heronry of Study Island 85dmi

Study Island 85 South, Middle Thoro

91. Island 85 South (Middle Thoro) is a circular, undiked dredged material island located in Cape May County at 39° 15' N and 74° 39' W. It is adjacent to the New Jersey Intracoastal Waterway, less than 1.0 km from the barrier beach, and about the same distance northwest of Corson's Inlet. It is south of Study Island 85dmi and separated from it by salt marsh, creeks, and another small dredged material deposit. The 0.9 ha dredged material deposit on 85 South (13.6 ha) was last used for dredged material deposition in 1966. The island has a tidal range of 1.1 m and is fairly flat with an elevation of approximately 0.5 m at the center of the dredged material deposit area. Vegetation was characterized by a late seral stage, though plant communities indicative of mid-seral stages were also present (Appendix B).

92. A ring of salt pannes extending from the low salt marsh bordered the dredged material deposit. The periphery of the upland area was dominated by an open area of marsh elder 1.0-m high and with a dense ground cover of high marsh species dominated by black grass. Scattered common reed was found with the black grass. A band of 1.0 to 1.5-m high reed, mixed with equal height marsh elder, groundsel, and bayberry, with black grass and red fescue grass dominating the herb layer inside the periphery. Shrubs, dominated by 2.0 to 3.9-m high bayberry and marsh elder covered the center of the deposit area. Reed was scattered through the shrub thickets. Winged sumac (*Rhus copallina*) and poison ivy were also common. Occasional 2.0 to 4.0-m high red cedars were also present (Figure 21).

Study Island 98A, Sturgeon Island

93. Island 98A (Sturgeon Island) is an elliptically shaped, undiked dredged material island located in Cape May County at 39° 05' N and 74° 46' W. It is 6.4 km northwest of Hereford Inlet, about 6 km southwest of Townsend's Inlet, and 0.20 km from the New Jersey Intracoastal Waterway. Island size was approximately 5.9 ha and dredged

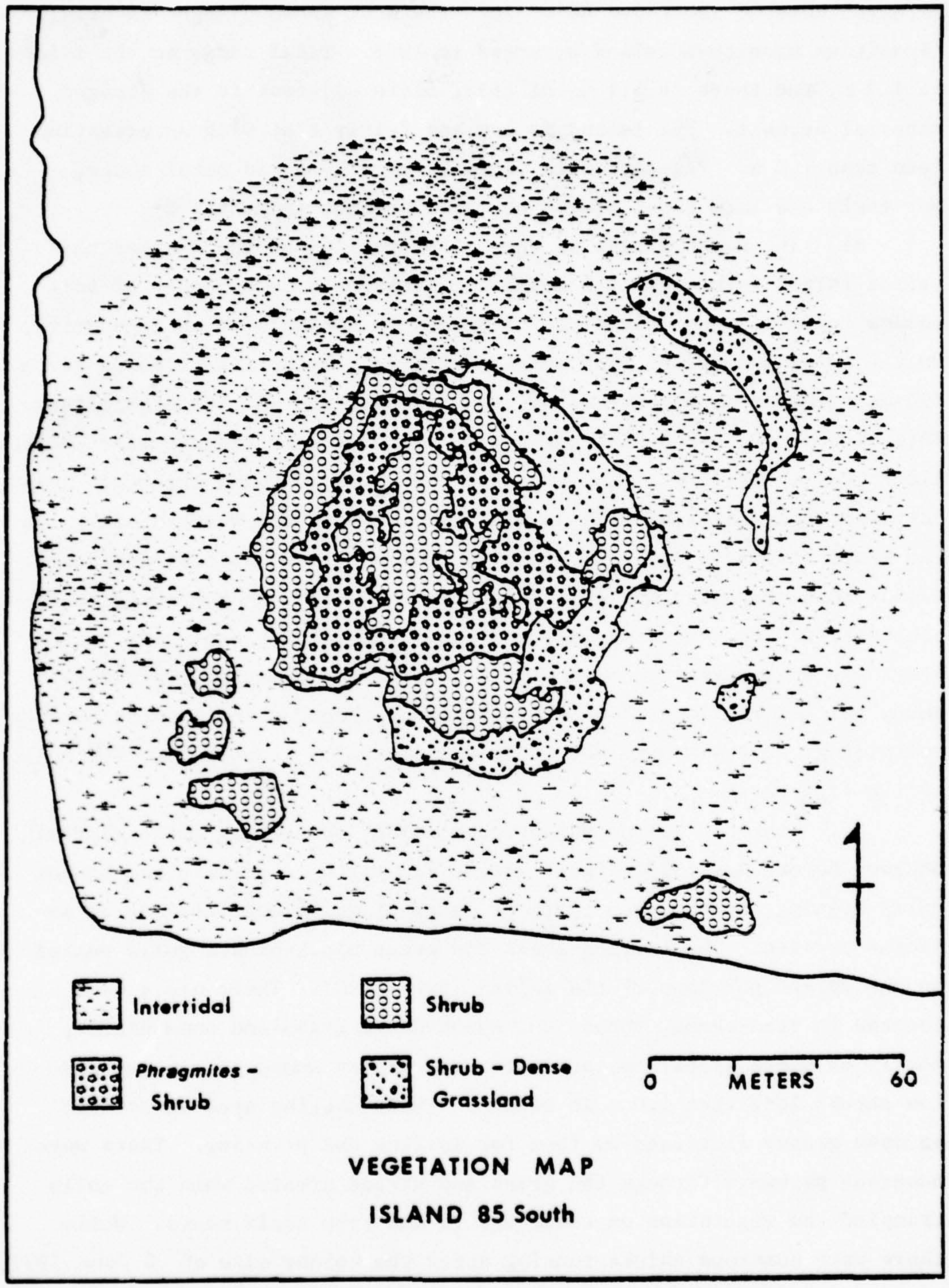

Figure 21. Vegetation map of Study Island 85 South

material covered about 0.8 ha of it. The last known dredged material deposition upon this island occurred in 1968. Tidal range on the island is 1.3 m, and there is 5.1 ha of tidal flats adjacent to the dredged material deposit. The island is low and fairly flat with an elevation less than 1.0 m. Vegetation is characterized by a mid seral stage, but early and late seral stages are also present (Appendix B).

94. The western side of the upland portion of the dredged material island is mostly high marsh dominated by a lush carpet of saltmeadow cordgrass and saltgrass surrounded by a ring of high tide drift. On the upper end of the high marsh, drift left by spring tides or storm flooding rested at the border of shrub communities and the high marsh. This high marsh hooked in between two rows of shrubs (Figure 22). Marsh elder grew in the high marsh and upon the drift, forming the outer border of dredged material uplands with the marsh on the western side. On the eastern side, a 1.0 to 3.0-m high reed-shrub association dominated. Common reed, bayberry,and groundsel were the most common members of this association. On the marsh side and still within this community, marsh elder was an important component. A small area of bayberry-groundsel shrub thicket was located on the southeast. Another small shrub thicket containing one 2.4-m high red cedar was centrally located near the hook of the high marsh.

95. Sturgeon Island supported a colony of herring gulls that was unknown before May 1977. There were a few pairs of great black-backed gulls nesting, and a dozen pairs of laughing gulls were nesting on adjacent marshes. The herring gulls and great black-backed gulls nested on the upland portions of the island (Figure 23). Their nests were located in reed-shrub, shrub, and shrub-dense grassland communities, mostly on dense grassland, and were well hidden among poison ivy and low shrubs less than 1.0 m in height. Their nesting area surrounded an open grassy area used by them for loafing and preening. There were numerous pathways through the grass and shrubs created when the gulls trampled the vegetation on their way to and from their nests. While there were numerous chicks running about the colony site on 6 June 1977, several nests still had eggs. A green heron may have been nesting on

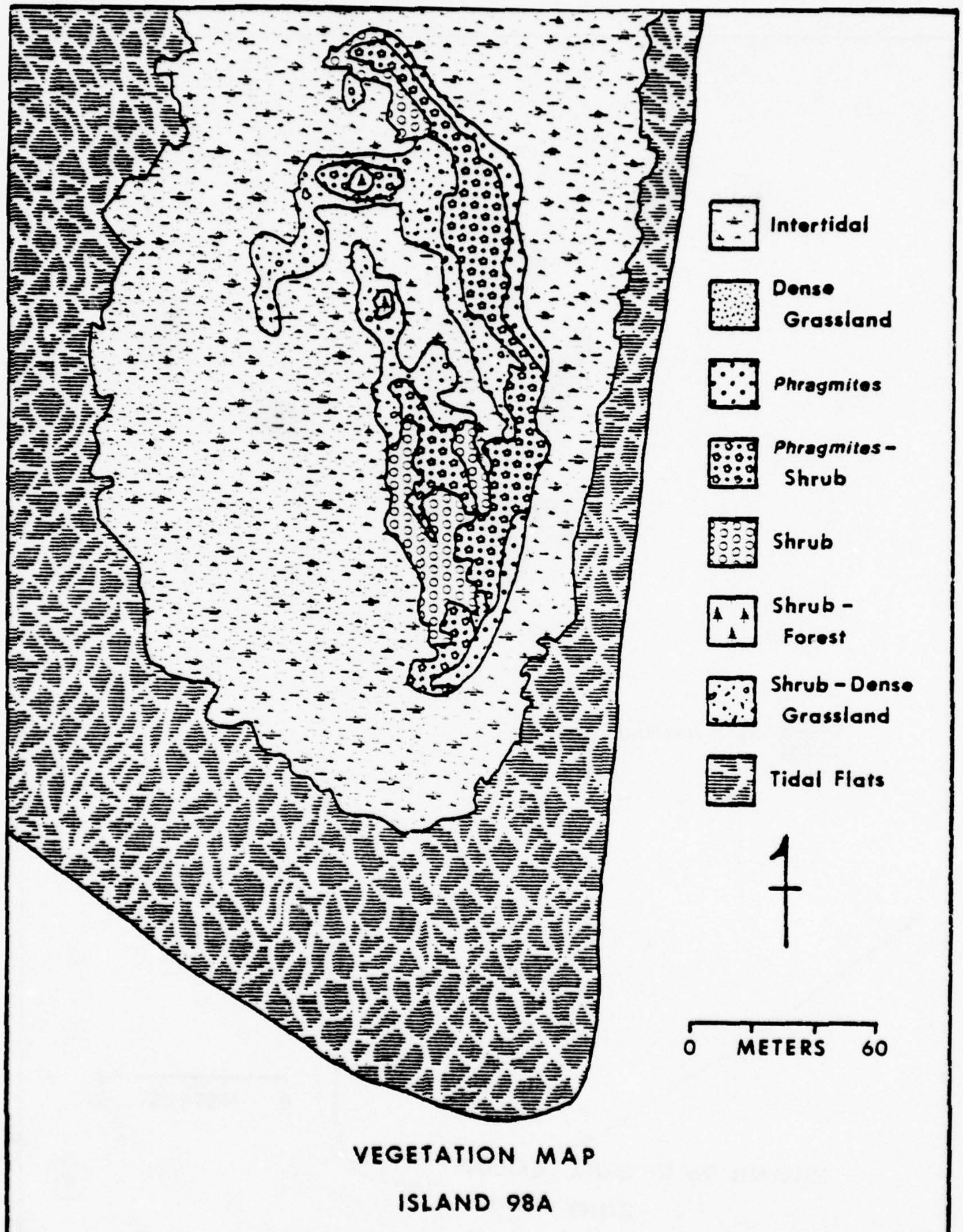

Figure 22. Vegetation map of Study Island 98A

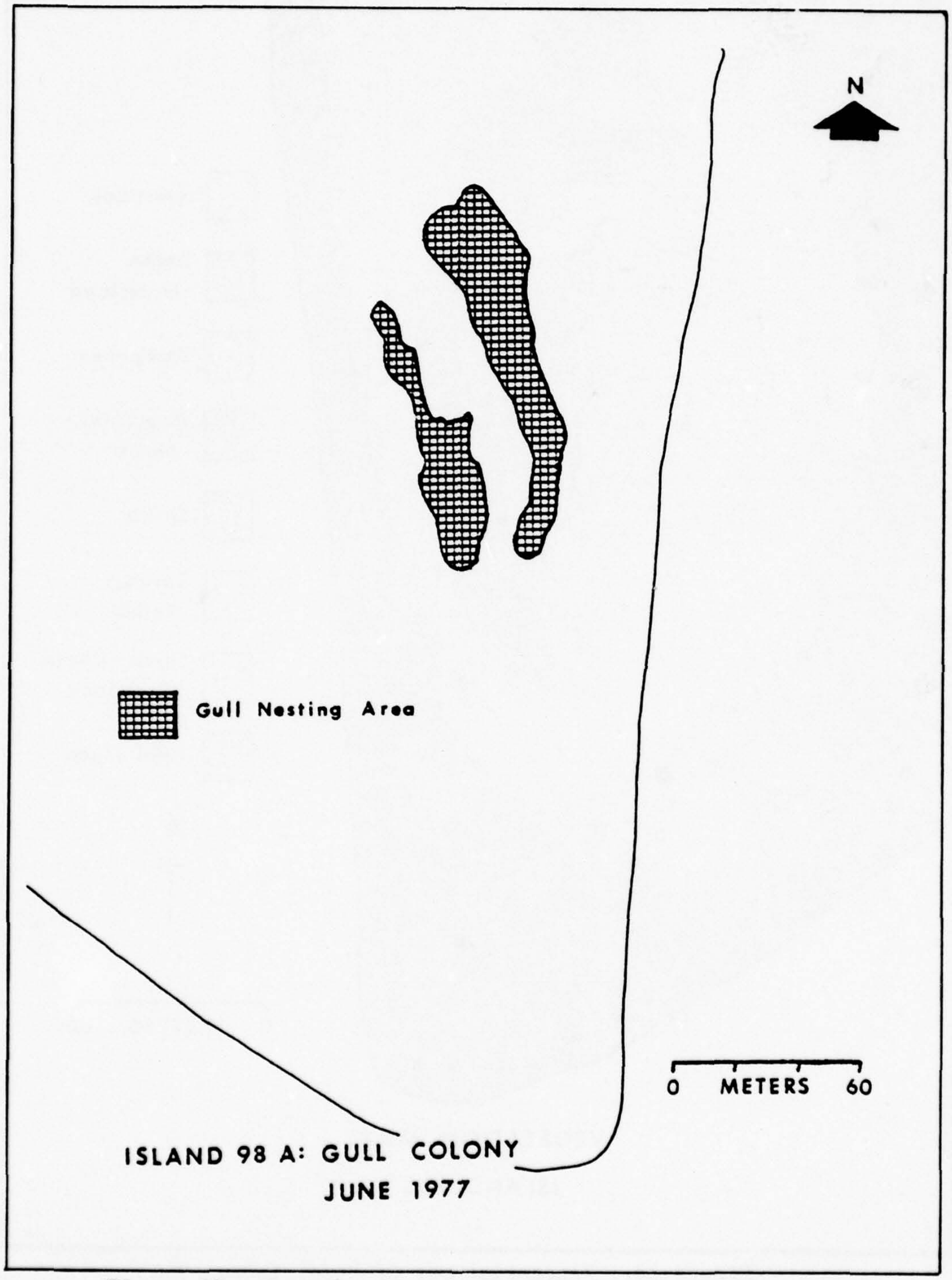

Figure 23. Map of gull colony on Study Island 98A

the island since it was observed roosting several times in a 2.4-m high red cedar. However, no nest was located. The nearest gull colony to Island 98A was located close by at Gull Island North (colony 98B, Figure C2), a distance of 0.68 km.

Study Island 108B

96. Island 108B is a triangularly shaped, undiked dredged material island also in Cape May County. Located at 39° 00' N and 74° 50' W, it is adjacent to the New Jersey Intracoastal Waterway and is about 3.2 km southwest of Hereford Inlet on the edge of Richardson Sound. The island is approximately 2.8 ha in size and the dredged material deposit upon it was approximately 0.2 ha. The island was last used for dredged material deposition in 1965. Its tidal range is 1.3 m and 0.2 ha of tidal flats are adjacent to the dredged material deposit. The island is fairly low and flat with an elevation under 1.0 m. Vegetation on Island 108B was characteristic of an early seral stage but mid seral stage vegetation was also present (Figure 24).

97. The island was surrounded by salt marsh and shallow water. The dredged material deposit was dominated by 1.0 to 2.0-m high stands of common reed. A band of marsh elder and orach was mixed with the reed The northern side of the deposit had a band of marsh elder and high marsh species dominated by saltmeadow cordgrass. The elder and reed sections were separated by a band of drift vegetation.

Study Island 98B North, Gull Island North

98. Island 98B North (Gull Island North) is a circular, undiked dredged material island in Cape May County. It is adjacent to the New Jersey Intracoastal Waterway and located 39° 05' N and 74° 47' W. It is about 6 km southwest of Townsend's Inlet and 6.4 km northwest of Hereford Inlet. The dredged material deposit area is about 0.5 ha on a 14.5 ha dredged material site. It was last deposited upon in 1968. Tidal range in this area is 1.3 m and 1.3 ha of tidal flats were adjacent

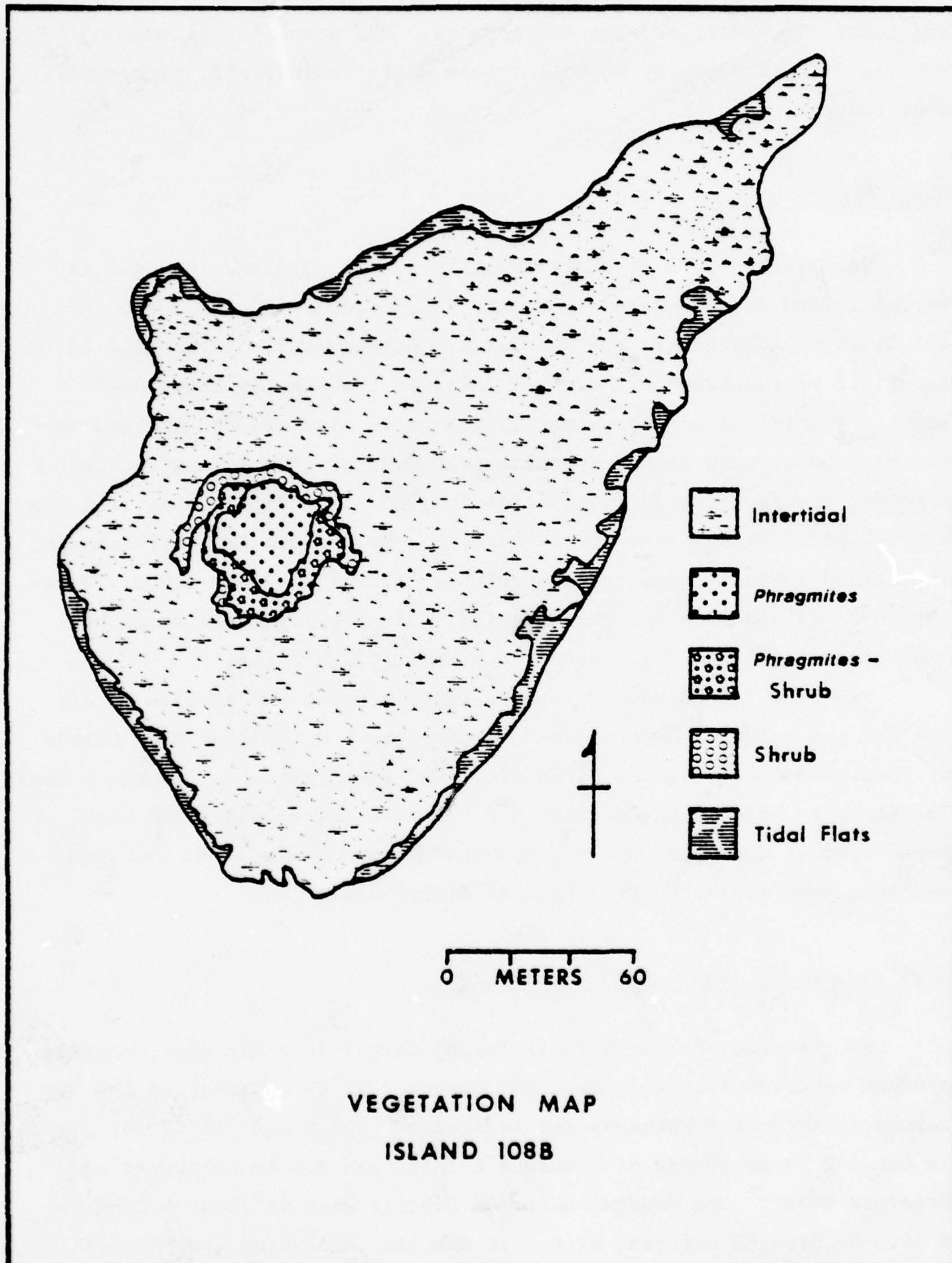

Figure 24. Vegetation map of Study Island 108B

to the dredged material deposit. Gull Island Islandis a fairly flat, low site and its elevation was less than 0.5 m. The dredged material deposit is surrounded by salt marsh and tidal pools which separate it from another dredged material deposit on the site directly south of it (98B South). Vegetation on Island 98B North was characterized by mid-seral stages though early and late seral stage vegetation was also present (Figure 25).

99. Less than 20 m of salt marsh separates the dredged material deposit from several large salt pannes in the upper marsh. The dredged material deposit was nearly surrounded by a mixture of marsh elder and a ground cover of high marsh species including saltmeadow cordgrass and black grass. Moving in towards the deposit center, an even mixture of marsh elder and common reed was abundant. This mixture gave way to a band of nearly solid common reed. The center of the island was a shrub thicket dominated by bayberry and groundsel. Reed was abundant and several 2.0 to 4.0-m high red cedar and black cherry (*Prunus serotina*) trees were also present.

100. Gull island North supported a mixed-species heronry and a small herring gull colony (Figure 26). This island was not a previously known colony site (Appendix A) and was discovered during the May 1977 survey. By 6 June 1977, some young were present but most heron eggs were beginning to hatch while the gulls had both eggs and young. The herons were nesting in reed, reed-shrub, and shrub-forest communities, with most of their nests in bayberry, groundsel, and marsh elder shrubs 1.5 to 3.0 m high. The herring gulls nests were at the periphery of the dredged material deposit and were in dense grasses very often at the base of low elder, goldenrod, and groundsel in a shrub vegetation community (Figure 26). The nearest heronry was 0.12 km away at Island 98B South (Gull Island South). The nearest gull colony was located on Sturgeon Island (98A), only 0.68 km away (Figure C2).

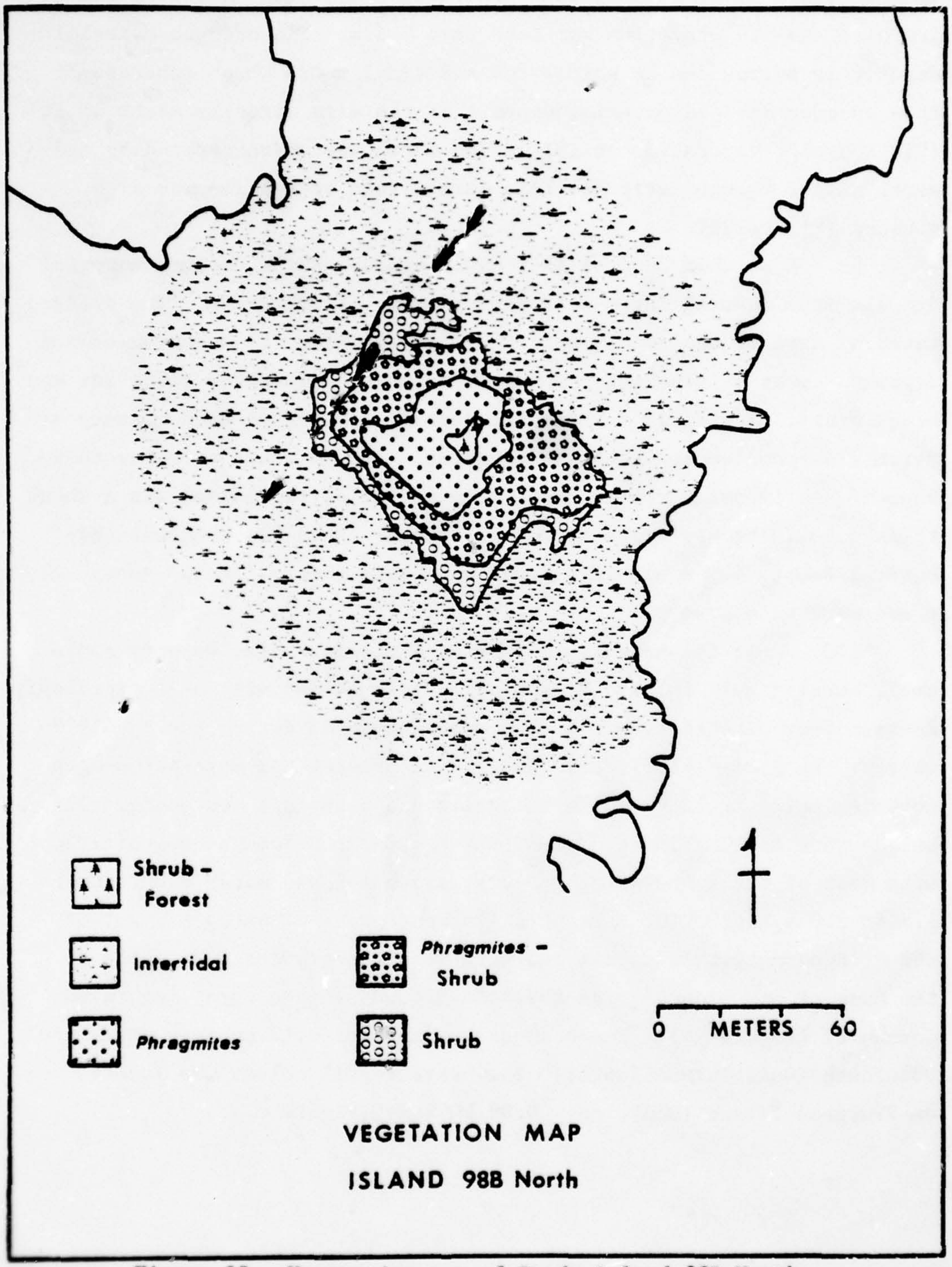

Figure 25. Vegetation map of Study Island 98B North

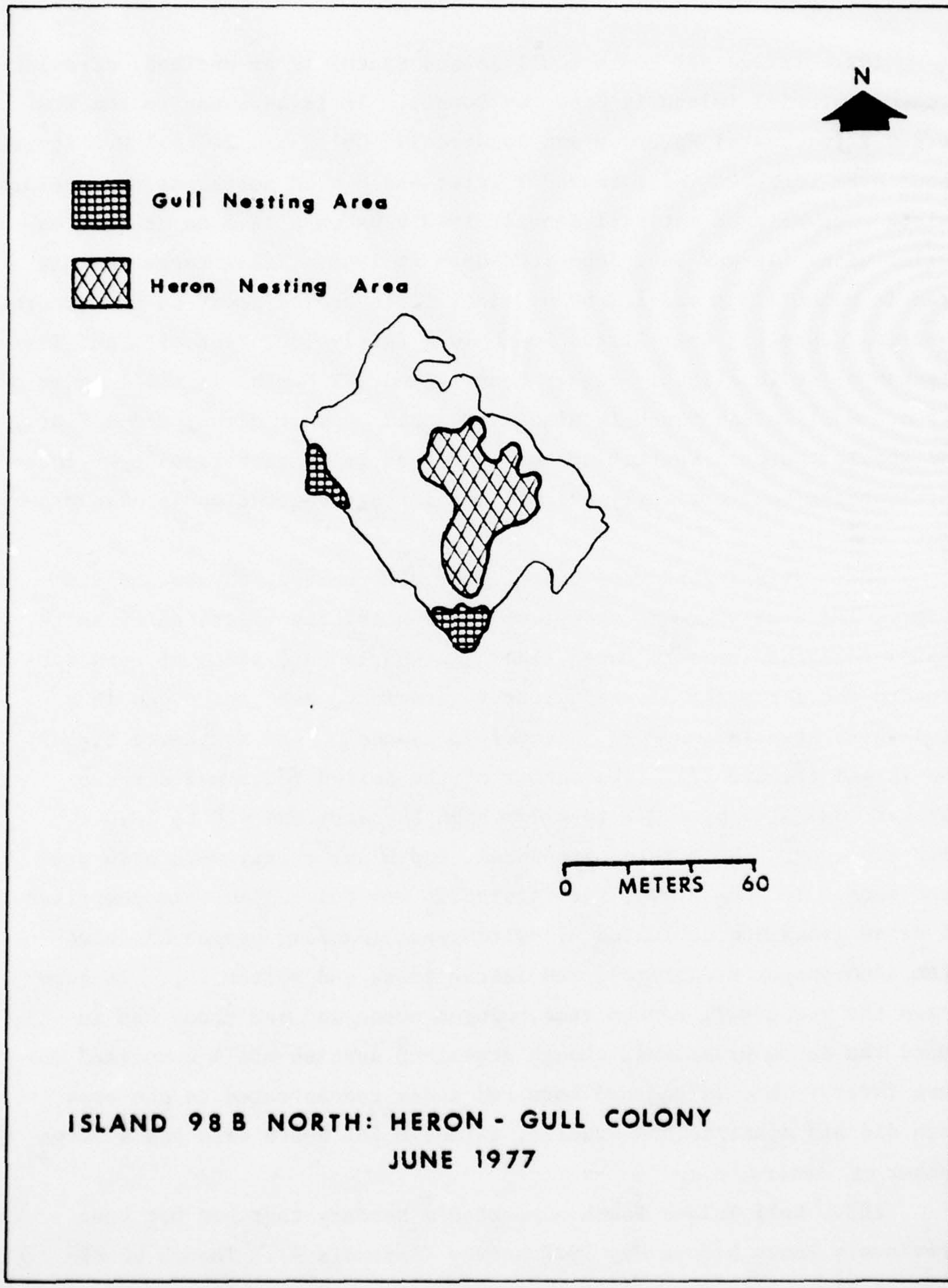

Figure 26. Heron-gull colonies on Study Island 98B North

Study Island 98B South, Gull Island South

101. Island 98B South (Gull Island South) is an undiked, circular dredged material island in Cape May County. It is adjacent to the New Jersey Intracoastal Waterway and located 39° 05' N and 74° 47' W. It is about 6 km southwest of Townsend's Inlet and 6.4 km northwest of Hereford Inlet. The dredged material deposit is 0.9 ha on a 14.5 ha dredged material site. It was last deposited upon in 1968. Tidal range in this area is about 1.3 m and 1.3 ha of tidal flats are adjacent to the dredged material deposit. Gull Island South is a fairly low, flat site and its elevation, while slightly higher than Island 98B North, is still under 0.5 m. Gull Island South is also surrounded by salt marsh, tidal flats, and shallow water. Vegetation on the island is characterized by a late seral stage; however, early and mid seral stage vegetation is also present.

102. This island was dominated by common reed, shrubs and red cedar. The area where marsh met upland was chiefly vegetated by saltmeadow cordgrass beneath marsh elder. A nearly pure stand of reed surrounded the perimeter of the uplant vegetation. Reed and elder in a reed-shrub association were in equal dominance on the southeast tip of the island (Figure 27). The center of the island contained a shrub thicket dominated by a 2.0 to 4.0-m high bayberry and 4.0 to 10.0-m high red cedar. Some reed, groundsel, and black cherry were also present here. In some areas, the vegetation was quite open and comprised of dense grassland dominated by switchgrass (*Panicum virgatum*), bluestem (*Andropogon scoparius*), red fescue grass, and poison ivy. In some areas the groundsel, common reed, winged sumac, and red cedar had invaded the dense grassland, though grassland species still comprised an herb layer. This island had more red cedar concentrated in one area than did any other island studied, although 78B South also had a large number of cedars.

103. Gull Island South supported a heronry that had not been previously known before May 1977 survey (Appendix A). Though black-crowned night herons were not observed on the 6 June 1977 census,

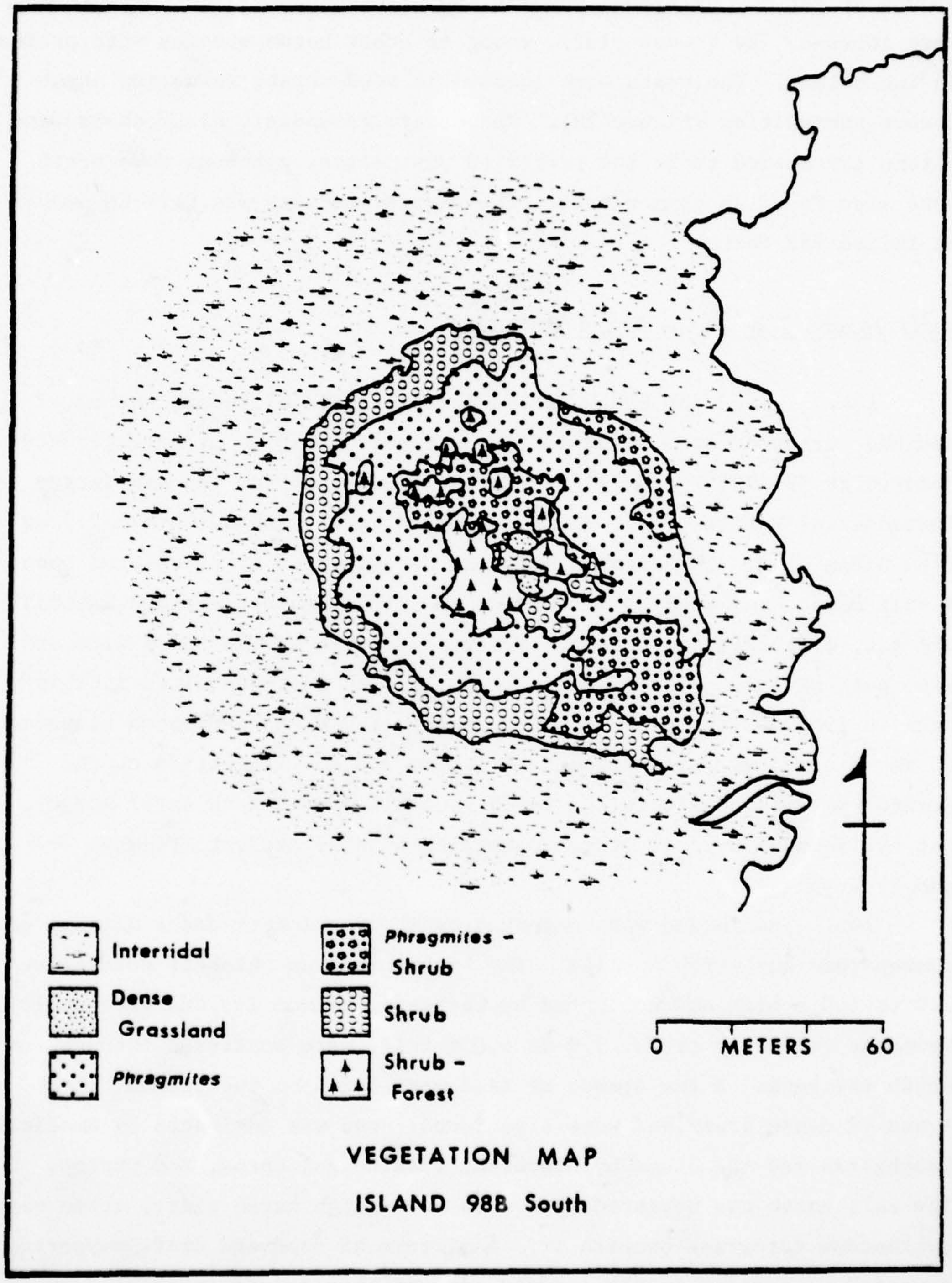

Figure 27. Vegetation map of Study Island 98B South

eight pairs had been found in May 1977 and four birds were seen on 8 June at the colony site. However, no black-crowned night heron nests were located. By 6 June 1977, young of other heron species were present in the colony. The nests were located in reed-shrub, shrub,and shrub-forest communities (Figure 28). Red cedar, groundsel, black cherry,and poison ivy seemed to be the preferred nest sites, although some nests were also found in common reed. The nearest heronry was 0.12 km away at Island 98B North.

Study Island 78B South, Broad Thorofare

104. Island 78B South (Broad Thorofare) is a linear, narrow, undiked dredged material deposit upon a salt marsh in Atlantic County. Located at 39° 19' N and 74° 34' W, it is 0.40 km from the New Jersey Intracoastal Waterway, 1.8 km from Somer's Point, and less than 2.7 km from Ocean City. The dredged material deposit, 3.4 ha, is placed upon a salt marsh estimated to be 50.9 ha in size. Another dredged material deposit, circular and undiked, is directly north of the study site and also part of Island 78B. Dredged material was last deposited in this area in 1969. Tidal range in this area is 1.2 m and estimated elevation of the dredged material deposit is 1.0 to 2.0 m. Vegetation on the dredged material study island is characterized by a late seral stage but early and mid seral stage vegetation is also present (Figures 29a and 29b).

105. The island was dominated by shrub thickets and a mixture of common reed and shrub species. The interior shrub thickets were about 2.0 to 4.0 m high and dominated by bayberry, poison ivy,and groundsel. Numerous red cedar trees, 3.0 to 6.0 m tall, were scattered through the shrub thickets. A few stands of reed were found on the island. Two types of dense grassland were also found: one was dominated by American beachgrass and the other by bluestem, seaside goldenrod, and yarrow. The salt marsh was bordered by 1.0 to 2.0-m high marsh elder, often with saltmeadow cordgrass beneath it. A mixture of sand and drift supported a varied vegetation on the seaward edge of the dredged material deposit.

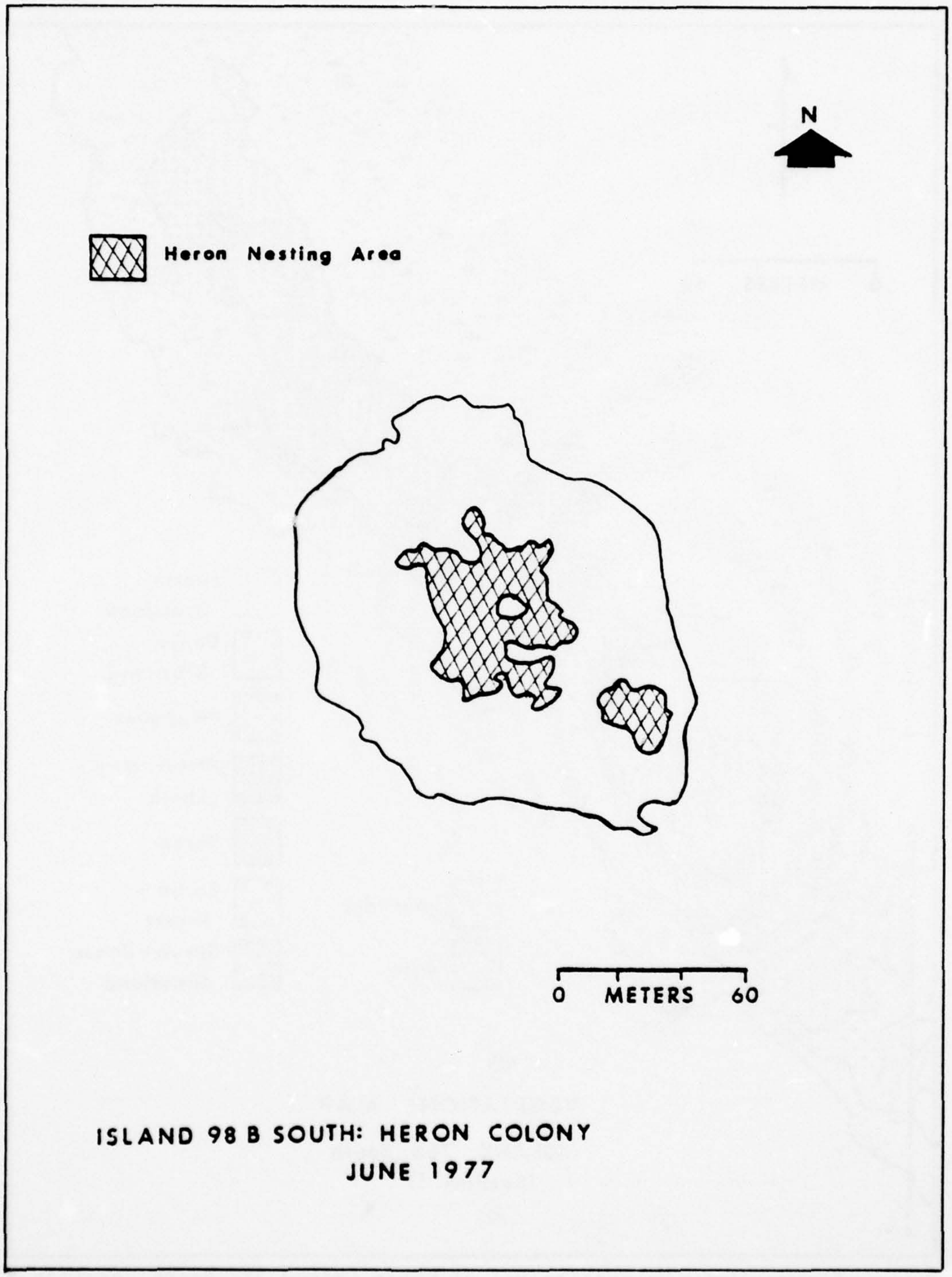

Figure 28. Map of heronry on Study Island 98B South

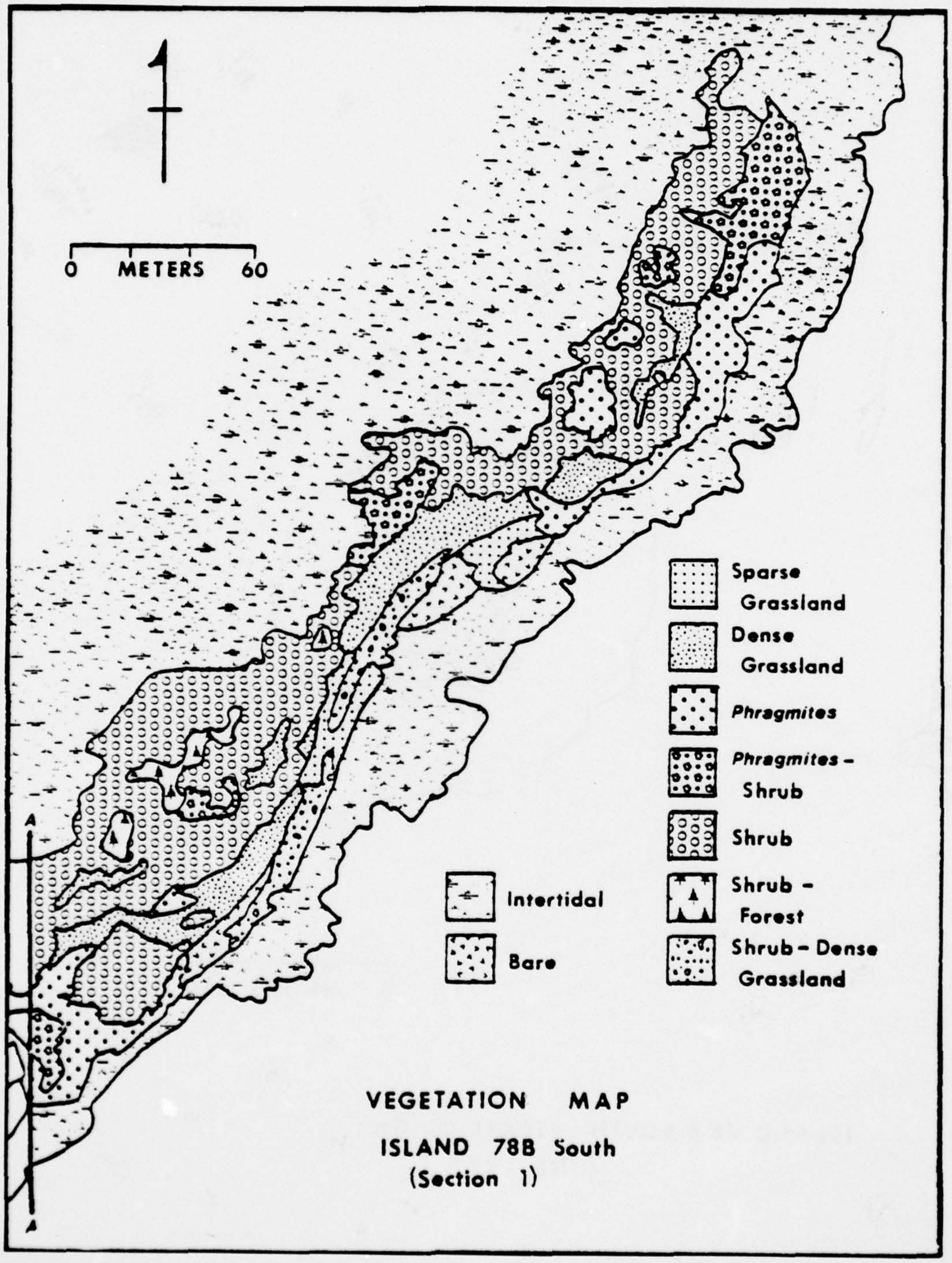

Figure 29a. Vegetation map of Study Island 78B South, section 1

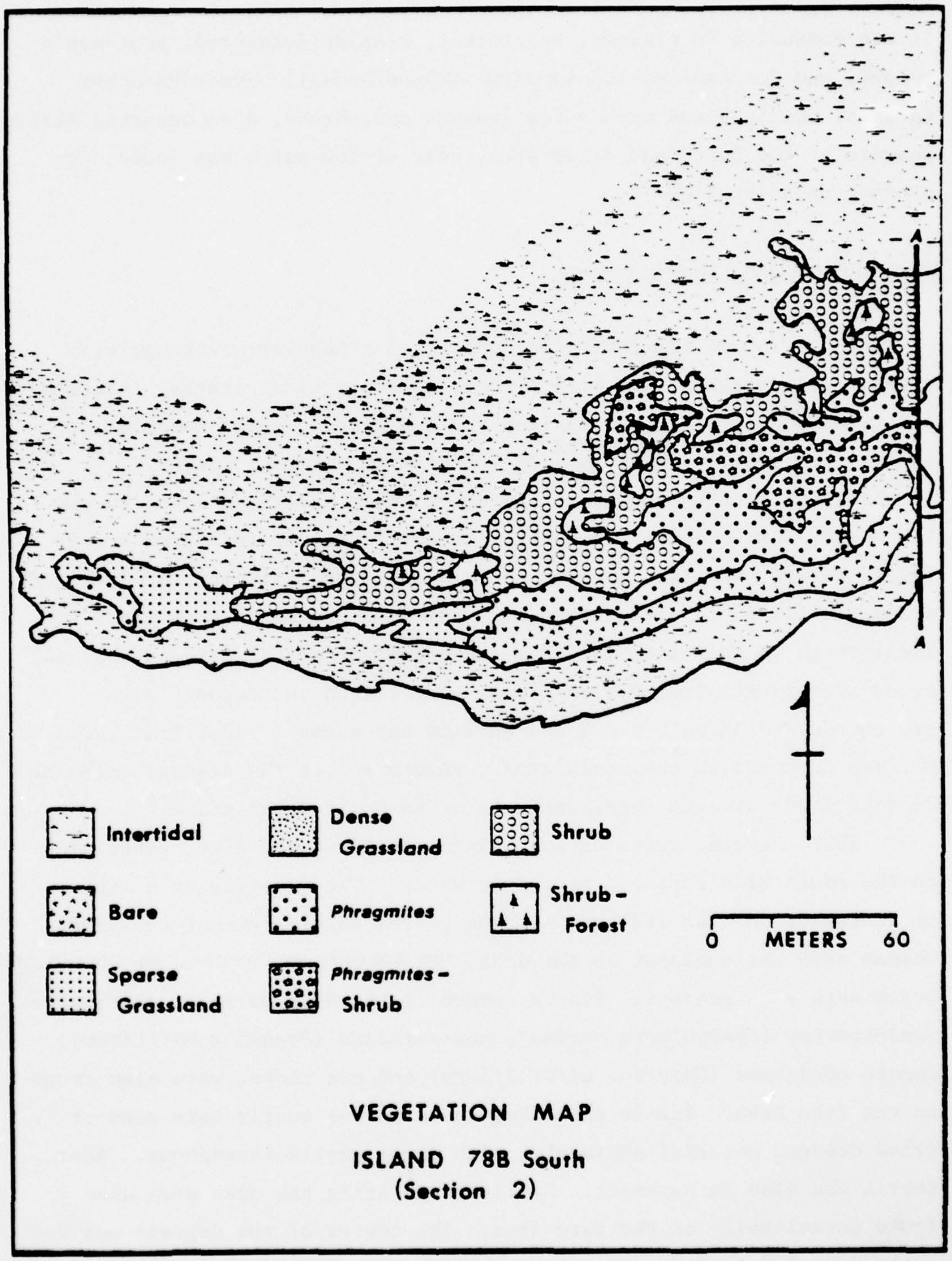

Figure 29b. Vegetation map of Study Island 78B South, section 2

It was dominated by pigweed, sea rocket, seaside goldenrod, poor-man's pepper, and Mexican tea (*Chenopodium ambrosioides*). Numerous other species, mostly herbs with a few grasses and shrubs, also occurred here. Seaward of the beach and drift area, peat or low marsh was found, depending upon location.

Study Island 103, Nummy Island

106. Island 103 (Nummy Island) is an irregular, rectangularly shaped salt marsh island with a road, numerous tidal creeks, channels, and tidal pools, plus four undiked and one diked dredged material deposit. Located at 39° 02' N and 74° 48' W in Cape May County, it abutts the northwest side of Hereford Inlet and is adjacent to the New Jersey Intracoastal Waterway. The entire island is approximately 129.3 ha and the diked dredged material deposit, selected for detailed study, is 1.2 ha in size. This site was last deposited upon in 1975. Tidal range on this site is 1.2 m and elevation of the dredged material study area ranges from 0.3 to 1.2 m. The island and deposit area are surrounded by salt marsh and shallow bay areas. Tidal flats, 0.31 ha, are adjacent to the study area. Vegetation on the dredged material deposit study area is characteristic of an early seral stage.

107. Several areas of salt pannes bordered the dike, especially on the south side furthest from open water. The dike was in a state of disrepair on that side and in some places only a remnant remained. Common reed was dominant on the dike, and seaside goldenrod, saltgrass, and orach were also present. Plants common to the high marsh or drift areas, sand-spurrey (*Spergularia marina*), sea-purslane (*Sesuvium maritimum*), smooth cordgrass (*Spartina alterniflora*), and sea rocket were also found on the dike area. Inside the dike, the area was mostly bare sand or dried dredged material sediments, with large shells throughout. Some debris was also in evidence. Species vegetating the dike were also found occasionally on the bare area. The center of the deposit was vegetated by 1.0 to 2.0-m high common reed with some orach growing on the dried mud. Reed was advancing from the center onto the bare area

(Figure 30).

108. Nummy Island supported colonies of laughing gulls (*Larus atricilla*) and common terns on its salt marsh areas and great black-backed gulls and herring gulls on dredged material areas. The diked dredged material deposit study area supported a colony of 150 pairs of herring gulls and eight pairs of great black-backed gulls. Their nests were distributed through the bare, reed and dike vegetation communities (Figure 31). Nests were placed upon bare sand mixed with clam shell and often on the dike at the base of herbaceous plants, though many were on bare areas with no vegetation, and one was in an outfall pipe through the dike. Nests on the other dredged material deposits were often on bare sand and shell though many were in saltmeadow cordgrass and at the base of low shrubs and herbaceous vegetation. Evidence of rat predation and habitation were also found on these portions of the island.

109. Nummy Island was a nesting area for herring gulls, great black-backed gulls, and laughing gulls in 1976 (Appendix A) as well as 1977. By 6 June 1977 there were herring gull and great black-backed gull chicks running around. However, many of the herring gull nests still had eggs in them, while the great black-backed gulls were more advanced with all of them having large chicks. The laughing gulls and common terns had nests with eggs, though some clutches were incomplete. The nearest herring gull-great black-backed gull colony to Island 103 was only 0.2 km away and was also on Nummy Island on an undiked dredged material deposit on the northeast side of the tidal channel, with salt marsh separating it from the study site.

Study Island 85C, Devils Thoro

110. Island 85C (Devils Thoro) is a diked dredged material island in Cape May County. It is located at 39° 14' N and 74° 39' W, adjacent to the New Jersey Intracoastal Waterway, about 1.8 km northwest of Corson Inlet's, and is just north of Island 85dmi. A salt marsh and approximately 1 km separate the study island from a beach

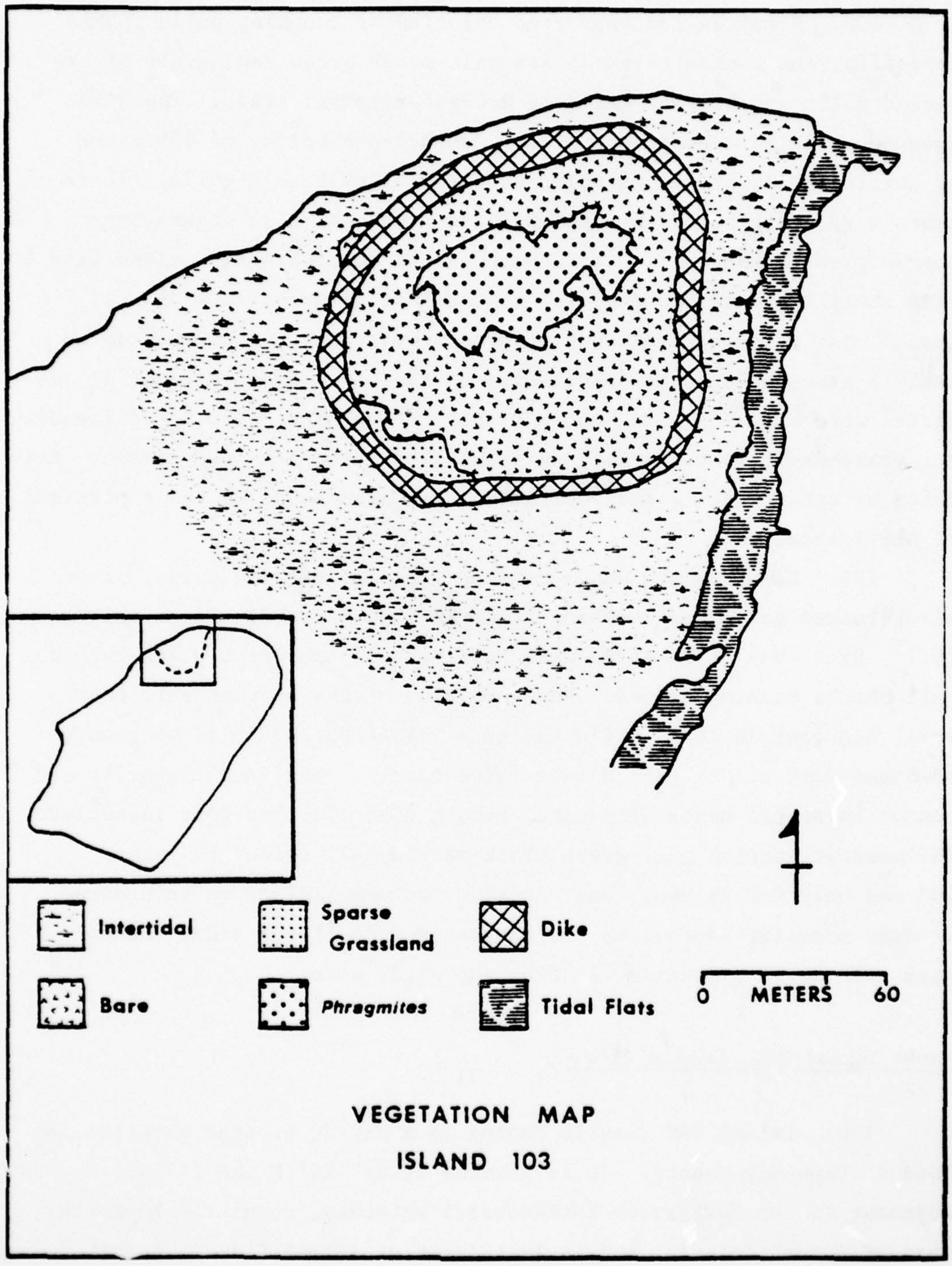

Figure 30. Vegetation map of Study Island 103

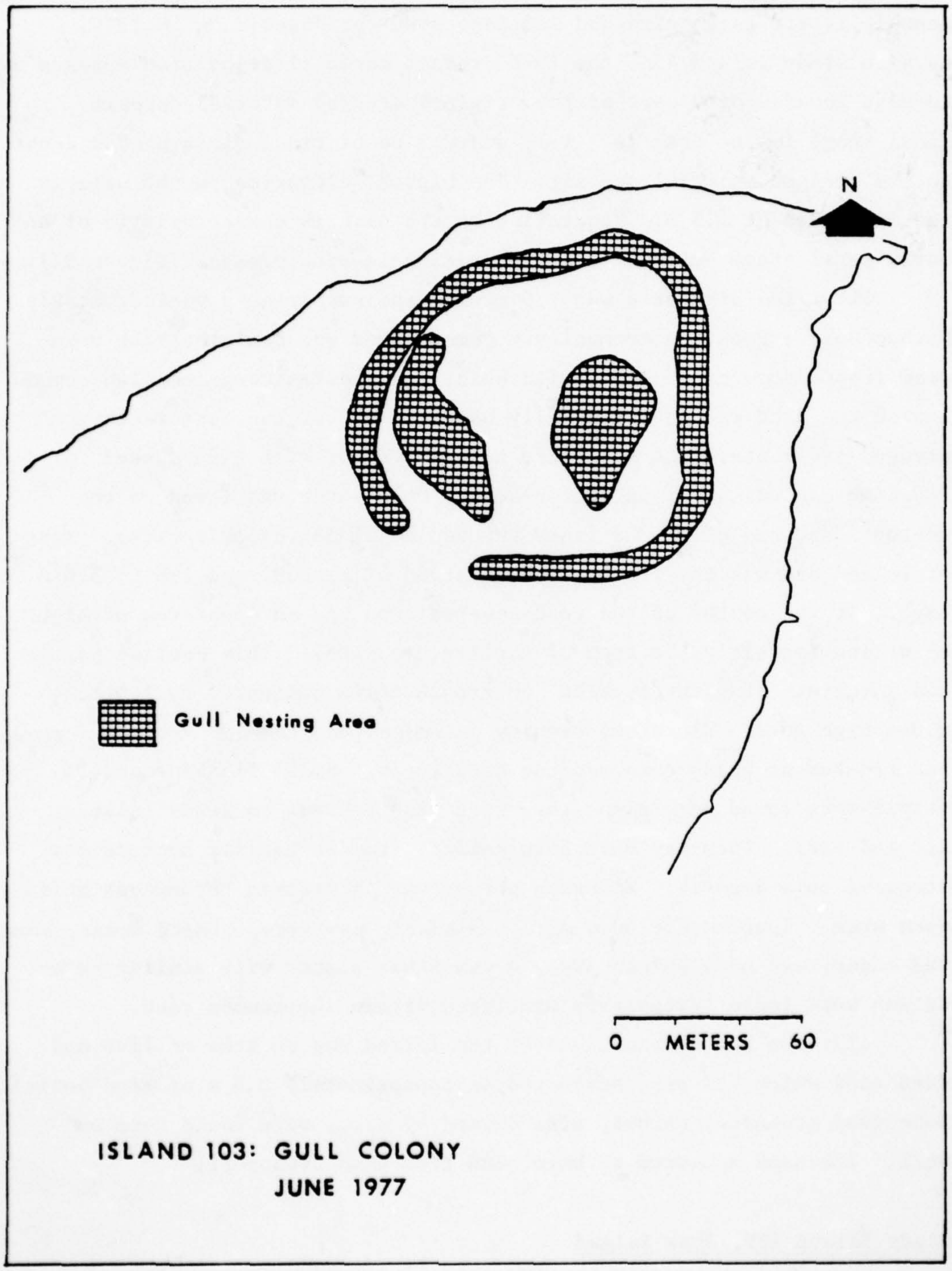

Figure 31. Map of gull colony on Study Island 103

development at the south end of Peck's Beach. The dredged material deposit is 4.0 ha in size and was last used for deposition in 1976. As with study Island 45A, the 1976 dredged material deposition appears to have covered only part of the original dredged material deposit. Tidal range in the area is 1.1 m, and 0.2 ha of tidal flats are adjacent to the dredged material deposit. The highest elevation on the site is the dike area at 1.5 m. Vegetation on the site is characteristic of an early seral stage but mid seral vegetation is also present (Figure 32).

111. The dike area was 1.0 m wide and supported a varied, mostly herbaceous, vegetation community. Common reed was dominant with pokeweed (*Phytolacca americana*), wild bean, and red fescue grass also common. Inside the dike was an essentially bare expanse of the most recent dredged sediments. The substrate here was sand, with blue mussel (*Mytilus edulus*) shell in some places. Open water was found on the southern end and dried mud lined the two adjoining deposit sides. Most of Island 85C was covered by a dense stand of common reed 1.8 to 3.0 m high. At the center of the reed-covered area was an open area of high elevation (possibly the apex of earlier deposits). This central portion had a variety of plant species and growth forms dominated by 1.0 to 2.0-m high reed. Bluestem, evening primrose (*Oenothera biennis*), yarrow, and red fescue grass composed the herb layer. Small fleabane and vulpia were found here also (they were also present on Study Islands A12 and 51B). They may have been relicts from an earlier successional stage of this deposit. Numerous shrubs were scattered throughout this open area. Species included were groundsel, bayberry, winged sumac, some red cedar, and some poison ivy. A few other places with similar vegetation were found irregularly scattered within the common reed.

112. On the northern end of the island was an area of live and dead reed which had been subjected to approximately 0.6 m of sand burial. Some dead groundsel shrubs, also buried by sand, were found here as well. The sand appeared to have been from wind transport.

Study Island 109, Shaw Island

113. Island 109 (Shaw Island) is an irregularly shaped, undiked

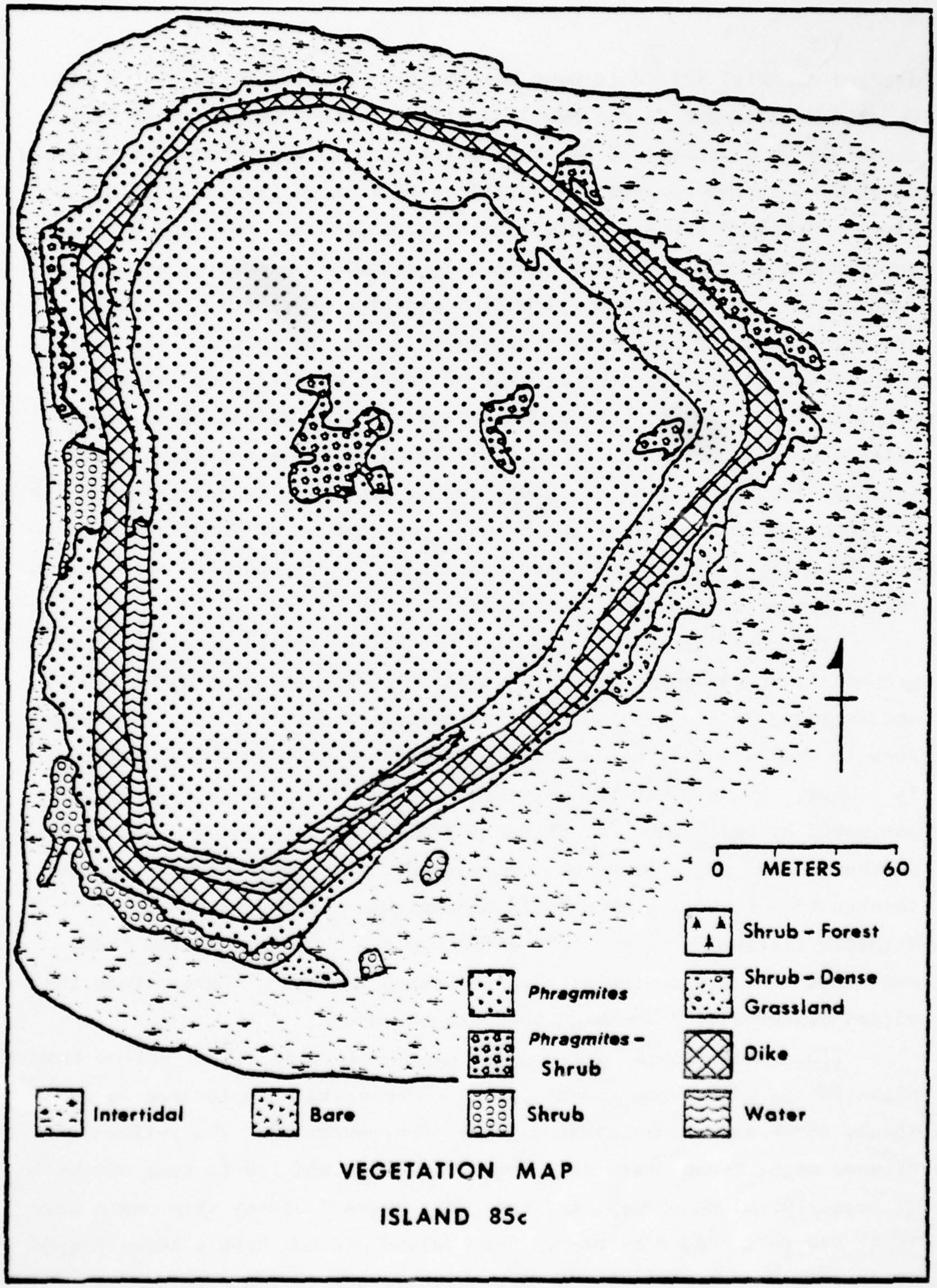

Figure 32. Vegetation map of Study Island 85C

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USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
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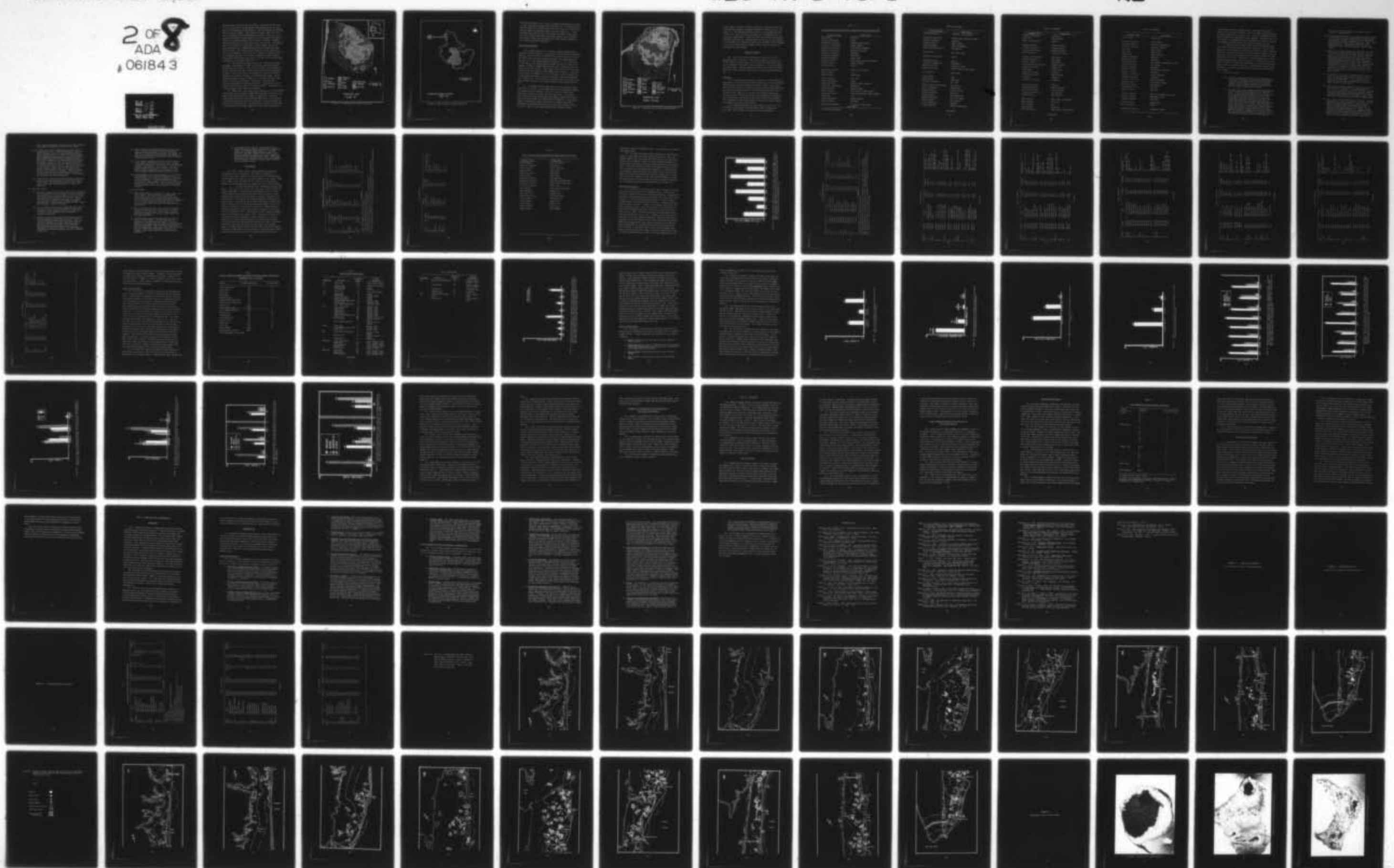

dredged material island in Cape May County. Located at 39° 59' N and 74° 51' W, adjacent to the New Jersey Intracoastal Waterway, it lies about 5.6 km southwest of Hereford Inlet and is separated from Wildwood Crest by a narrow channel. Shaw Island is a large island, 32.7 ha in size, containing several dredged material deposits. Only one 2.1 ha portion was studied, an area exhibiting circular vegetative growth patterns on the southwest and which also contains a heronry. A sewage treatment facility is on the southeast side of the island. The eastern side of the island has a great deal of debris (lumber, bottles and cans) washed up on it. Dredged material was last deposited on Shaw Island in 1965. Tidal range on this island is 1.3 m and tidal flats (2.1 ha) are adjacent to the study area. Elevation is estimated at 1.5 m on the highest portions of the island. Vegetation on Shaw Island is characterized by mid seral stage species but early and late seral stage vegetation is also present (Figure 33).

114. The island was a complex mixture of common reed, bayberry, groundsel, winged sumac, red cedar, marsh elder, and high marsh and successional drift species. The salt marsh border of the southwestern deposit area was salt panne in some places and abundant drift material in others. On the west side of the deposit were areas of high marsh dominated by saltmeadow cordgrass with abundant marsh elder. On the northeast side was a stand of common reed. The east side had a shrub thicket with bayberry, groundsel, winged sumac, poison ivy, and Virginia creeper (*Parthenocissus quinquefolia*). Occasional red cedar and black cherry also occurred in the shrub thickets. Large areas included mixtures of 3.0-m high reed and shrubs.

115. Shaw Island had a small heronry (Figure 34) of yellow-crowned night herons with a few glossy ibises whose nests were located in reed-shrub, shrub and shrub-forest vegetation communities. The yellow-crowned night heron nests were found both high and low in tall shrubs of bayberry, black cherry, and red cedar trees. Glossy ibis nests were lower and well hidden by reed. Shaw Island did not have a heronry upon it in 1976 as far as is known (Appendix A), but it has been used as a

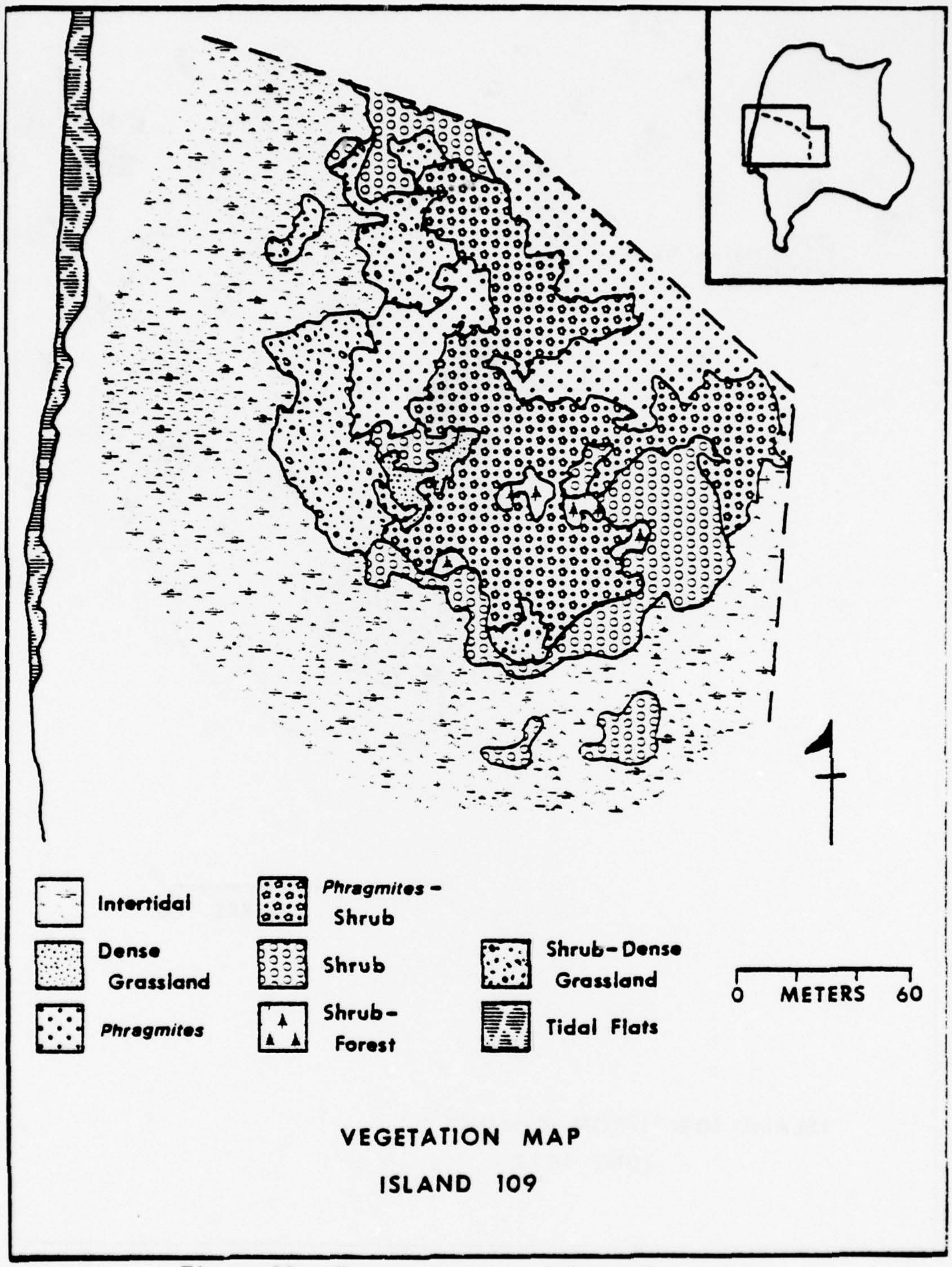

Figure 33. Vegetation map of Study Island 109

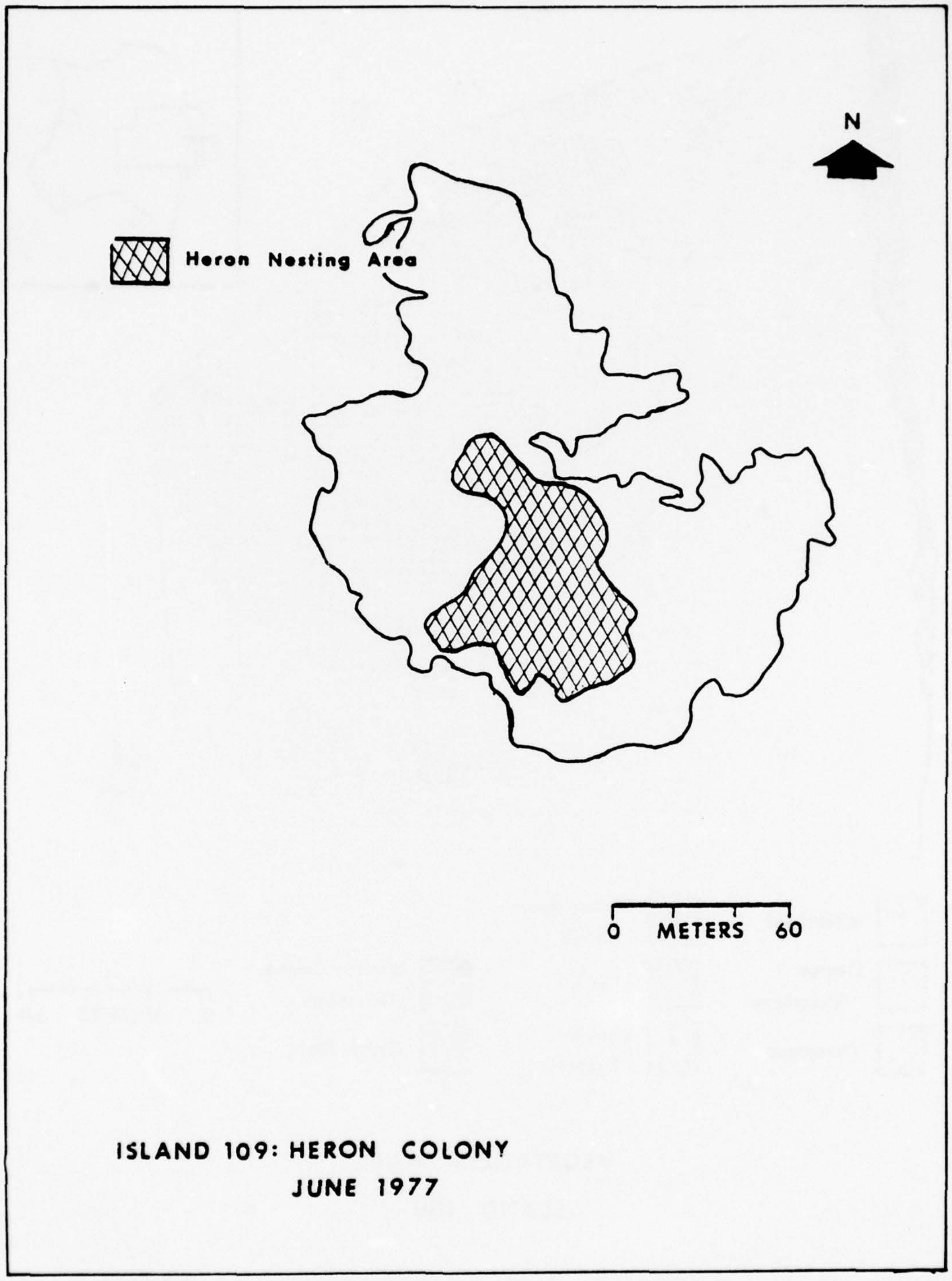

Figure 34. Map of heronry on Study Island 109

heron nesting colony site in the past (personal communication, May 1977, J. Lomax, Cape May Bird Observatory, Cape May, NJ). The nearest heronry with the same species as Shaw Island was 0.2 km across the Intracoastal Waterway Channel at Stingaree Point (colony 67, Figure C2). In 1976 Stingaree Point supported one of the largest heronries in New Jersey but a fox, observed on the May 1977 survey, seemed to have decimated this colony by June, when its numbers were badly depleted compared to the 1976 nesting season (Appendix A).

Study Island 109 South

116. Island 109 South is a circular, undiked dredged material island in Cape May County. It is adjacent to the New Jersey Intracoastal Waterway, located at 38° 59' N and 74° 51' W, about 3 km north of Cape May Inlet, and 6.4 km south of Hereford Inlet. The dredged material deposit is on a salt marsh opposite Wildwood Crest. It is almost 2 ha in size and the last dredged material deposition date for this site is unknown. However, dredged material deposition at unspecified sites in this area occurred in 1965. Tidal range in this area is 1.3 m and tidal flats (0.1 ha) are adjacent to the dredged material deposit. Elevation on the island is estimated at 1.0 m at the dome. Island 109 South has a small sand beach subject to heavy recreational use from passing boaters. Vegetation on Island 109 South is characteristic of an early seral stage but mid and late seral stage vegetation is also present (Figure 35).

117. The deposit area was vegetated on the south side by common reed, about 2.1 m high. In some areas winged sumac, groundsel, bayberry, and elderberry were codominant with reed. A few 3.0-m high black cherry and 3.6-m high red cedar were also found here. The northern part of this upland was characterized by Japanese honeysuckle (*Lonicera japonica*), which seemed to be draped over all vegetation. Dense grasslands of panic grass (*Panicum lanuginosum*), bluestem, broom sedge (*Andropogon virginicus*), and yarrow were found on the northeast side of this area. However, these grasslands had been invaded by shrubs

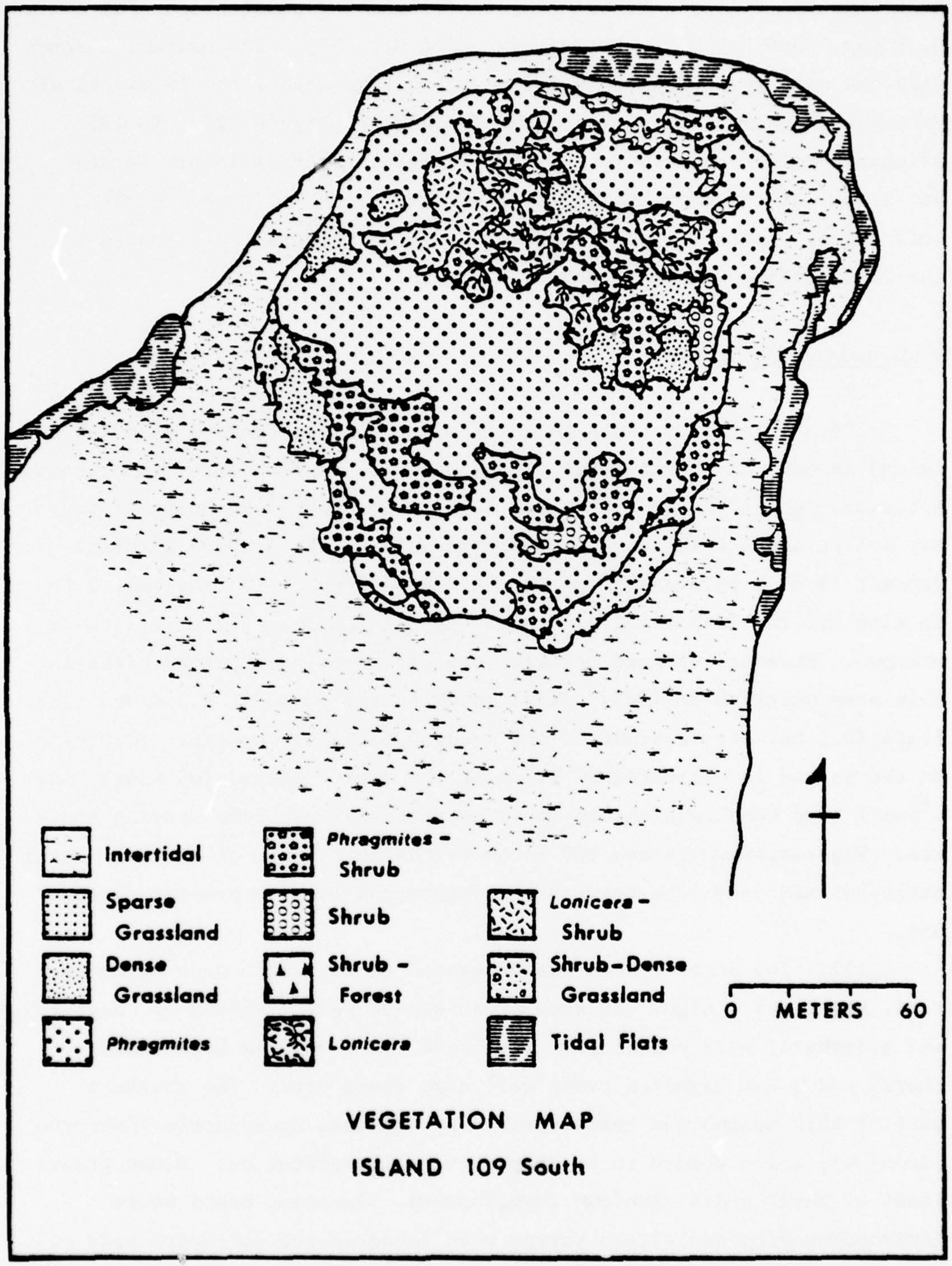

Figure 35. Vegetation map of Study Island 109 South

(winged sumac, groundsel, bayberry, elderberry, common reed) and vines. The viniferous vegetation included honeysuckle, Virginia creeper, and poison ivy. The honeysuckle grew not only in the grassland, but also climbed over dead reed stems and skeletons of groundsel and was, in large part, impenetrable. Island 109 South was the only study island which had honeysuckle as a dominant plant species and in such abundance. It even seemed to be displacing common reed. Specimens of white mulberry (*Morus alba*) and sassafras (*Sassafras albidum*) were also noted, and elderberry was quite common.

Vegetation Studies

118. Table 3 lists major plant species collected on the 21 dredged material study sites. This is not a complete listing of all species found in the study area, but is based upon field observations and on sampling of 1085 quadrats and 28 transects on the dredged material study islands. Species present were indicative of low tidal marsh, high tidal marsh, grassland, shrub-thicket, and dune-woodland communities.

Succession

119. Vegetational and successional patterns on study islands conformed well to those described by Martin (1959), Daiber (1974), Chapman (1960), Ranwell (1972) and Robichaud and Buell (1973) for the tidal salt marshes and dunes of the outer coastal plain of southern New Jersey. Analysis of successional trends on the study islands was based upon a relatively small sample of the 21 sites, investigated during only one field season. Records pertaining to the deposition of dredged material on specific sites along the New Jersey Intracoastal Waterway were incomplete or non-existent, making correlation of present vegetation patterns with island age difficult.

120. Reasonably reliable age records exist for only 13 of the 21 islands, so discussion of successional trends is based mostly upon them. Other islands are discussed only if successional

Table 3

Plant Species Found on New Jersey Dredged Material Study Islands 1977

Scientific Name	Common Name
**Acer rubrum*	Red maple
Achillea millefolium	Yarrow
Amaranthus retroflexus	Pigweed; green amaranth
Ambrosia artemisiifolia	Common ragweed
Amelanchier canadensis	Serviceberry; shadbush
Ammophila breviligulata	American beachgrass
Andropogon scoparius	Bluestem
Andropogon virginicus	Broom sedge
Apocynum cannabinum	Indian hemp
Arenaria peploides	Sea purslane; seabeach sandwort
**Asclepias syriaca*	Common milkweed
Atriplex patula	Orach
Baccharis helimifolia	Sea myrtle; groundsel
Bassia hirsuta	-----
Bromus tectorum	Brome grass
Cakile endentula	Sea rocket
Carex albolutescens	Sedge
Chenopodium album	Pigweed; lamb's quarters
Chenopodium ambrosioides	Mexican tea
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle; common thistle
Convolvulus sepium	Wild morning glory; hedge bindweed
Cyperus sp.	------
Cyperus esculentus	Yellow nutgrass
Cyperus odoratus	Nutsedge
Digitaria sanguinalis	Crab grass; finger grass

(Continued)

* No specimen collected

Table 3 (Continued)

Scientific Name	Common Name
Distichlis spicata	Saltgrass alkali-grass
Eragrostis spectabilis	Tumble grass; petticoat climber
Erigeron canadensis	Fleabane
Erigeron pusillus	Small fleabane
Eupatorium album	White thoroughwort
Eupatorium hyssopifolium	Thoroughwort
Festuca rubra	Red fescue grass
Gnaphalium obtusifolium	Catfoot
Hemerocallis fulva	Daylily
Heterotheca subaxillaris	Camphorweed
Hibiscus palustris	Swamp rose mallow
Hudsonia tomentosa	Beach heather; poverty grass
Iva frutescens	Marsh elder
Juncus dudleyi	Rush
Juncus gerardi	Black grass
Juniperus virginiana	Red cedar
Lactuca biennis or floridana	Wild lettuce
Lactuca canadensis	Wild lettuce
Lactuca scariola	Prickly lettuce
Lathyrus japonicus	Beach pea
Lechea maritima	Maritime pinweed
Lepidium virginicum	Poor-man's pepper
Limonium nashii	Sea lavender
Linaria canadensis	Toadflax
Lonicera japonica	Japanese honeysuckle

(Continued)

Table 3 (Continued)

Scientific Name	Common Name
Mollugo verticillata	Carpetweed
Morus alba	White mulberry
Myrica pennsylvanica	Bayberry
Oenothera biennis	Evening primrose
Oenothera fruticosa	Evening primrose
Oenothera parviflora	Evening primrose
Opuntia humifusa	Prickly pear cactus
Panicum dichotomiflorum	Panic grass
Panicum lanuginosum	Panic grass
Panicum virgatum	Switchgrass
Parthenocissus quinquefolia	Virginia creeper
Phragmites communis	Common reed
Pinus nigra	Austrian pine
Phytolacca americana	Pokeweed
Pluchea purpurascens	Marsh fleabane
Poa annua	Bluegrass
Polygonella articulata	Jointweed
Polygonum aviculare	Knotweed
Polygonum hydropiper	Common smartweed
Polygonum punctatum	Water smartweed
Polygonum ramosissimum	Bush knotweed
Prunus serotina	Black cherry
Rhus copallina	Dwarf sumac; winged sumac
**Rhus radicans*	Poison ivy
Rosa virginiana	Rose
Rubus bifrons	Blackberry
Rumex acetosella	Sheep sorrel; common sorrel

(Continued)

Table 3 (Concluded)

Scientific Name	Common Name
Rumex crispus	Yellow dock
Salicornia bigelovii	Dwarf saltwort
Salicornia europaea	Samphire; chickenclaws
Salicornia virginica	Perennial saltwort
Salix alba	White willow
Salix nigra	Black willow
Salsola kali	Common saltwort
Sambucus canadensis	Elderberry
**Sassafras albidum*	Sassafras
Scirpus americanus	Three-square; chair-maker's rush
Sesuvium maritimum	Sea purslane
Solanum americanum	Nightshade
Solanum dulcamara	Nightshade; bittersweet
Solidago altissima	Goldenrod
Solidago sempervirens	Seaside goldenrod
Solidago tenuifolia	Goldenrod
Spartina alterniflora	Smooth cordgrass
Spartina patens	Saltmeadow cordgrass
Spergularia marina	Sand spurrey
Strophostyles helvola	Wild bean
Suaeda lineraris	Sea blite
Teucrium canadense	American germander; wood sage
Trifolium arvense	Rabbitfoot clover
Triplasis purpurea	Sand grape
Vitis aestivalis	Summer grape
Vulpia octoflora	Vulpia
* *Xanthium strumarium*	Cocklebur; coltbur

relationships could be easily discerned. The islands selected for analysis were utilized as disposal sites from 1963 through 1969, with a six year gap before use again in 1975. Accurate determination of the ages of older plant associations was not possible. Because of this, it was difficult to determine the exact time period over which the present plant communities have reached their current succession status.

121. Age and extent of the dredged material island depositions are not the only factors influencing plant succession. Martin (1959) found that microtopography, groundwater availability, depth of sediment deposition, salt spray tolerance, and water and soil salinity were all important factors in the determination of vegetation patterns at nearby Island Beach, New Jersey. Frequency of, and susceptibility to, storm inundation (especially in areas with little or no elevation), the presence or absence of diking, seed availability, and seed transport mechanisms are also factors that should be considered when studying plant succession. The following discussions are of various stages found on study islands:

a. Early seral stages

(1) The plant communities classified as representing an early stage on dredged material islands in New Jersey varied with the deposition patterns on the islands studied: diked, domed, or spread in a low profile. Because of these configurational differences, their early successional stages also differed.

(2) On diked study islands, sediments deposited behind the dike were essentially unvegetated for at least two years. The dike probably restricted the introduction of colonizing seeds and rhizomes carried by tides and storms under natural conditions. Some of the first plants found on early seral stage diked study islands were saltgrass, sand spurrey, sea blite (*Suaeda maritima*), sea purslane, common reed, pigweed, orach, and blue grass (*Poa annua*). Salt-tolerant species are slower to colonize these diked dredged material areas because of the higher salinity of the sediments after the saltwater portion of the dredged material evaporates. Ponding from rainwater and/or flood waters that periodically cover parts of the rim-like depositions and are retained within the dike,

would also retard colonization by pioneer species intolerant of standing water.

(3) Diked study islands 45A, 85C, and 103 were in early stages of succession. The dikes surrounding the deposits were in more advanced stages of colonization and succession than the areas internally adjacent to them. High, central portions were also more vegetated than lower areas surrounding them. Common reed seemed to be the predominant species, colonizing almost all areas on such islands.

(4) Several of the study islands (A12, A12 North, 51B) were dome shaped. They ranged in elevation from less than 1.0 m to 3.0 m above the salt marsh surface. Definite ages for most of them are lacking. The bare sand, shell, and/or pebbled areas on the dome top were often invaded by sedges (*Cyperus* sp.), vulpia, sand grape (*Triplasis purpurea*), brome grass, small fleabane, and evening primrose (*Oenothera parviflora*). These species (or combinations of them) formed a sparse grassland community at the highest elevations on several of the domed islands studied and represented an early seral stage on deposits that were at least 12 years old in some instances.

(5) At the base of the dome, dense grassland was typically found; it was most often composed of American beachgrass and seaside goldenrod. The lower areas were colonized by common reed. Data indicate that over a period of time the dense grassland species cover the dome, followed by common reed.

(6) Many of the same sparse grassland species on early seral stage domes were also present in less abundance on 11 to 14 year old summits in mid seral stages. These had mostly dense grassland species with some shrub invasion. Vegetation maps suggest that domed deposits take longer to advance beyond an early seral stage of sparse grassland than do islands with less elevated dredged material.

(7) Most of the islands studied had a low profile. No study islands were in early seral stages, but common reed was probably a major pioneer species. Reed advances by rapid rhizome growth and forms tall, dense stands. It is one of the earliest and most persistent of all species invading these deposits. For example, Island 108B (12 years old) was dominated by common reed which occurred in a single dense stand although some mid seral growth had begun. Periodic inundation of low-lying deposits by storm and high tides seems to maintain early

seral stages by drowning or salting out the less tolerant woody species characteristic of later seral stages.

(8) On older low profile dredged material islands, dense grasslands were found. The dense grasses may have been initial invaders or may have been followed by earlier sparse grassland species. On some low profile islands, drift (cordgrass and reed stems) covered large portions. These islands had characteristic succession patterns which varied somewhat from islands previously described. For example, Island A35 is in an area where the natural vegetation community is tidal salt marsh, and most of its surface was covered by drift. The drift was invaded by sea rocket and orach. The island periphery had smooth cordgrass, *Bassia hirsuta*, and common saltwort (*Salsola kali*) growing in abundance. Interior portions had an open, herbaceous cover dominated by goldenrod, seaside goldenrod, and poor-man's pepper. Vines growing were wild bean and wild morning glory.

(9) Islands did not differ in mid and late seral stage vegetation to the same extent that they differed in early seral stages. Characterizations of later seral stages apply to the study islands regardless of their configeration.

b. Mid seral stages

(1) Mid seral stages on Study Islands A59a, 98A, and 98B North were characterized by shrub invasion of sparse grassland, dense grassland, or pure reed stands. The oldest deposit which had mid seral vegetation was nine years old, and the stage probably begins at an earlier age. Shrubs usually found in this stage are bayberry, groundsel, and marsh elder. Winged sumac was common on some islands and elderberry occurred occasionally.

(2) At the central portion of some islands with dense grassland, the mid seral stage was initiated by both reed and shrubs. This situation occurred on islands with subdomes of lower elevation than the main dome (Islands 45A and 85C).

(3) Islands with much drift vegetation were characterized at mid seral stages by reed, bayberry, and/or poison ivy growing through open herbaceous vegetation. Where upland areas bordered salt marsh, marsh elder (with or without reed) grew through mats of drift material. Marsh elder was scattered and/or mixed with reed throughout the upper salt marshes. On Islands 85dmi and A59a elder-high marsh mixtures may have been invaded by common reed.

(4) On most islands the reed-shrub mixture covered a large area. In time, the shrubs mixed with the reed will probably exceed the height of the reed and dominate the association. However, shrub domination was observed where the shrub thickets had probably become established before invasion by reed.

(5) In some areas, especially in early reed-shrub associations, numerous shrub skeletons were found. Islands 45A and A61c contained a larger number of these skeletons than most other islands. A late frost in May 1977 was probably responsible for this. Saltwater flooding during storms or dredged material deposition on pre-existing shrub associations produces similar effects.

(6) Grasslands were only a minor component of the mid seral stage islands, but the grassland communities were probably important to the earlier development of the shrub thicket communities. In dense grassland succession, the grasses and herbs common in the earlier seral stages persisted in the ground layer. With increasing density of the reed-shrub canopy, the grasslands will probably disappear.

c. Late seral stages

(1) Shrub thickets were considered a late seral stage on the study islands. Shrubs establish on dredged material deposits either alone or mixed with common reed. Shrubs dominating the reed-shrub associations increase in cover and density to form thickets. Islands 9 through 14 years old (A61c, 98B North, 109) showed this, but the ages of the deposition from which the shrubs grew were undetermined.

(2) Most of the same species occurring in mid-seral stage uplands dominated the later seral stages of bayberry, groundsel, and winged sumac. Marsh elder, sometimes mixed with groundsel and bayberry, formed thickets on the deposit perimeter.

(3) The shrub-forest was the most advanced seral stage observed on study islands. The most important tree species were red cedar and black cherry. The trees appeared to be randomly spaced through the shrub thickets and were occasionally found in mid seral stage shrub-grassland communities. Shrub-forest was found on 12 to 14 year old islands (109, 98B South). Poison ivy and Virginia creeper were common within the shrub-forest community.

(4) Data areavailable on the age, characteristic seral stage, other stages present, and vegetation communities present on each study island (Table 4). No plant species or vegetation communities were found at the study sites that were atypical of the salt marshes and sand dune habitats of southern New Jersey. Additional discussion of the vegetation found on all study islands and its relation to colonial nesting birds is presented in the following sections.

Bird Studies

122. Table 5 lists colonial nesting seabird and wading bird species that occur in New Jersey. Only great blue herons (*Ardea herodias*) and roseate terns (*Sterna dougallii*) were not found nesting in the study area in June 1977, and green herons were not common. Least terns, common terns, gull-billed terns (*Gelochelidon nilotica*),and Forster's terns were nesting in the study area, as were black skimmers ( ), great black-backed gulls, laughing gulls,and herring gulls. Little blue herons (*Florida caerulea*), great egrets (*Casmerodius albus*), snowy egrets, Louisiana herons (*Hydranassa tricolor*), black-crowned night herons, yellow-crowned night herons, and glossy ibises comprised the wading bird species studied. Appendix A provides a detailed account of the history and breeding phenology of these species in New Jersey. Herring gulls, great black-backed gulls, laughing gulls, Forster's terns,and all of the above wading bird species were in colonies and nesting by the second week of May 1977. Common terns were arriving at colonies from early May and were already on nest sites by 8 May in northernmost sites. Black skimmers, least terns,and laughing gulls were returning to New Jersey in May. By the first week of June, all species had nests, eggs,and/or young, though many of the black skimmers were not yet nesting, and many of the gulls were renesting after high storm tides had washed away their nests. Many of the herons had young, though many other nests had only eggs or newly hatched young. The wading bird species had started arriving on their breeding territories in New Jersey as early as March; in June some were renesting because certain colony sites had just been burned (Pork Island) or

Table 4

Deposit Age and Seral Stage Relationships

Island	Last Deposit+	Dominant Plant Communities	Characteristic Seral Stage	Other Seral Stages Present
A12	pre 1969*	GS-P-PS	early	mid
A35	pre 1969*	P-GD-PS-S	early	mid; late
45A	1976	B-P-GD(S)	early	none
X27	pre 1969*	GS-S-P-PS	late	early; mid
A61c	pre 1959**	P-S-PS	early	mid; late
85dmi	1966	P-S-PS	late	early; mid
98A	1968	PS-SGD	mid	early; late
98B North	1968	P-S-PS	mid	early; late
98B South	1968	P-PS-SF	late	early; mid
103	1975	B-P	early	none
109	1965	P-S-PS-SF	mid	early; late
A12 North	pre 1969*	B-P-PS	early	mid; late
A43a	pre 1969	P-PS	early	mid

(Continued)

+ by U.S. Army Engineer District, Philadelphia.

* Fred Lesser, Ocean County Mosquito Control Commission

** Based upon bird banding data, U.S. Fish and Wildlife Service, Patuxent, MD.

P = reed; S = shrub; PS = reed-shrub; SF = shrub-forest; GS = sparse grassland; GD = dense grassland; GD(S) = dense grassland with shrubs; B = bare; SGD = shrub-dense grassland; L = honeysuckle; LS = honeysuckle-shrub.

Table 4 (Concluded)

Island	Last Deposit+	Dominant Plant Communities	Characteristic Seral Stage	Other Seral Stages Present
45B	1963	P-PS	early	mid; late
51B	1965	P-PS-GS-GD	early	mid
A59a	1968	P-PS-GS-SGD	mid	early; late
78B South	1969	PS-S-SF	late	early; mid
85c	1976	B-P-GD(S)	early	mid; late
85 South	1966	S-PS-SGD	late	mid
108B	1965	P-PS	early	mid
109 South	1965?	P-PS-L-LS	early	mid; late

Table 5

List of Colonial Nesting Seabirds and Wading Birds in New Jersey

Scientific Name	Common Name
Ardea herodias	Great blue heron
Butorides virescens	Green heron
Florida caerulea	Little blue heron
Bubulcus ibis	Cattle egret
Casmerodius albus	Great egret
Egretta thula	Snowy egret
Hydranassa tricolor	Louisiana heron
Nycticorax nycticorax	Black-crowned night heron
Nyctanassa Violacea	Yellow-crowned night heron
Plegadis falcinellus	Glossy ibis
Larus marinus	Great black-backed gull
Larus argentatus	Herring gull
Larus atricilla	Laughing gull
Gelochelidon nilotica	Gull-billed tern
Sterna forsteri	Forster's tern
Sterna hirundo	Common tern
Sterna dougalli	Roseate tern
Sterna albifrons	Least tern
Rynchops niger	Black skimmer

disturbed by predators (Stingaree Point). By late August, all species had fledged young.

123. The survey and census figures presented in the following pages are based upon June 1977 census and survey data. These are minimal figures since birds away from their nests at the time of the census were not counted. Figures for the Stone Harbor Heronry are probably much lower than the actual breeding population of this major site. Counts were difficult because of the protected nature of the site, its large size, and impenetrable vegetation. Ground truthing and additional census/survey data from others in the area (Kane and Farrar 1977; Burger and Lesser 1976; personal communication, January 1978, Joan Galli, Division of Fish, Game and Shellfisheries, Trenton, NJ) indicate that the census figures are within reasonable estimates of the breeding populations of these species in the study area.

Survey of colony sites

124. A total of 117 colony locations were found during the June 1977 survey from Cape May Inlet to Manasquan Inlet. Common terns nested at 52 sites and were the most widespread species. Herring gulls occurred at 40 sites and were also widespread, often with common terns and herons. Great black-backed gulls occurred at 21 sites, always in small numbers and usually with herring gulls. Laughing gulls were found nesting at 31 sites, mostly in salt marshes, and did not nest north of Barnegat Inlet. Least terns occurred at 15 sites early in June and black skimmers were found at 14 sites, though they did not breed at all of them. Gull-billed terns were found breeding at three locations and Forster's terns at six. Heronries were located at 32 sites and were of mixed species composition. Figure 36 indicates the percentage of the total number of sites with each wading bird species. Black-crowned night herons, snowy egrets and glossy ibises were most widely distributed, and cattle egrets were least widely distributed (6 of 32 sites). No heronries were located north of Barnegat Inlet. Table 6 records the locations, names, and species composition at each site where a nesting colony was found. The site numbers refer to the

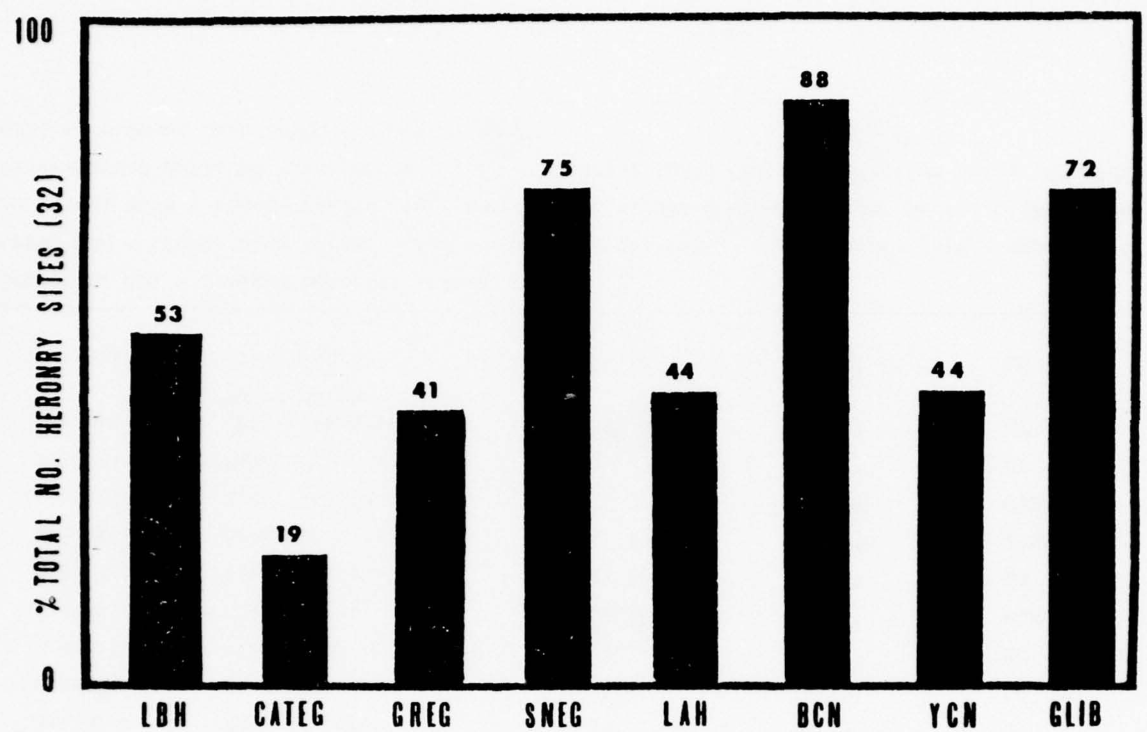

Figure 36. Wading bird species distribution on colony sites, showing percentages of heron sites by species. LBH= little blue heron; CATEG= cattle egret; GREG= great egret; SNEG= snowy egret; LAH= Louisiana heron; BCN= black-crowned night heron; YCN= yellow-crowned night heron; GLIB= glossy ibis

Table 6

1977 Coastal Nest Sites

Site No.	County	Name	Latitude	Longitude	Species Present
41	Atlantic	Absecon Inlet North	39°23'	74°24'	LT
45a*	Atlantic	Alex Island East & West	39°22'	74°31'	LG,CT
48	Atlantic	Bass Harbor	39°17'	74°35'	LT
46	Atlantic	Beach Thorofare	39°20'	74°31'	LG, CT
36a	Atlantic	Betsey Channel	39°26'	74°22'	HG, LG, FT, CT
60 dmi	Atlantic	Black Point	39°26'	74°24'	BCNH
38*	Atlantic	Bonita Tideway	39°24'	74°24'	LG, CT
78A dmi	Atlantic	Broad Thorofare	39°19'	74°34'	BCNH
35	Atlantic	Elder Island	39°27'	74°20'	GBBG, HG, CT
42a*	Atlantic	Flat Thoro	39°25'	74°25'	CT
38*	Atlantic	Golden Hammock Thoro Marsh	39°23'	74°24'	CT
33	Atlantic	Great Thoro	39°29'	74°21'	LG

(Continued)

* = new site location; dmi = dredged material island;

GNH = green heron; LBH = little blue heron; CATEG = cattle egret; GREG = great egret; SNEG = snowy egret

LAH = Louisiana heron; BCNH = black-crowned night heron; YCNH = yellow-crowned night heron; GLIB = glossy ibis;

GBBG = great black-backed gull; HG = herring gull; LG = laughing gull; GBT = gull-billed tern; FT = Forster's tern;

CT = common tern; LT = least tern; BLSK = black skimmer

Table 6 (Continued)

Site No.	County	Name	Latitude	Longitude	Species Present
34	Atlantic	Hammock Cove Island	39°27'	74°24'	SNEG, BCNH, GBBG, HG
47	Atlantic	Hospitality Creek	39°18'	74°34'	GBBG, HG, LG, CT, BLSK
A61b dmi	Atlantic	Islajo	39°25'	74°25'	LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB, HG
36	Atlantic	Little Bay	39°26'	74°23'	GBT, CT
29	Atlantic	Little Beach Island	39°30'	74°20'	HG, CT, BLSK
31	Atlantic	Little Beach Island	39°30'	74°20'	BCNH, YCNH
31	Atlantic	Little Beach Island	39°30'	74°20'	LBH, SNEG, BCNH, YCNH, GLIB
A61c dmi	Atlantic	Little Heron Island	39°24'	74°26'	LBH, CATEG, GREG, SNEG, LAH, BCNH, GLIB, GBBG, HG
35	Atlantic	Little Mud Thoro	39°27'	74°21'	CT
39	Atlantic	Little Panama (Brigantine Blvd.)	39°23'	74°24'	BCNH, YCNH, GLIB
47a	Atlantic	Longport Sod Banks	39°19'	74°33'	LT
61 dmi	Atlantic	Oyster Thoro Marsh	39°26'	74°24'	GBBG, HG, LG, GBT, CT, BLSK
A59a dmi	Atlantic	Perch Cove Point (Big Shad Island)	39°28'	74°24'	BCNH, YCNH
40	Atlantic	Peter Beach	39°23'	74°24'	LT
46	Atlantic	Pork Island	39°20'	74°32'	YCNH (GREG, SNEG, BCNH, YCNH, GLIB nests burned out)
32	Atlantic	Pullen Island (Little Beach South)	39°28'	74°20'	GNH, CATEG, GREG, SNEG, BCNH GLIB
77 dmi	Atlantic	Risley Channel	39°20'	74°33'	GBBG, HG, LG, CT
30*	Atlantic	Seven Island (Newman Thoro)	39°31'	74°20'	GREG, SNEG, LAH, BCNH, GLIB

(Continued)

Table 6 (Continued)

Site No.	County	Name	Latitude	Longitude	Species Present
34a*	Atlantic	Simkins Thoro	39°28'	74°22'	LG, FT
42	Atlantic	Stake Thoro	39°23'	74°25'	GBBG, HG
37	Atlantic	Somers Bay	39°26'	74°23'	LG,CT
44a*	Atlantic	Ventnor City	39°21'	74°30'	LBH, SNEG, BCNH, YCNH, GLIB
44	Atlantic	Ventnor City Beach	39°21'	74°30'	LT
38a*	Atlantic	Wading Thoro	39°25'	74°26'	LBH, GREG, SNEG, LAH, BCNH, GLIB, GBBG, HG
45	Atlantic	Whirlpool Island	39°21'	74°31'	HG, LG, GBT, CT
58a*	Cape May	Avalon	39°06'	74°44'	GREG, SNEG, BCNH
53	Cape May	Burroughs Hole	39°11'	74°41'	LG,FT
71	Cape May	Cape May Inlet	39°57'	74°52'	SNEG, BCNH, YCNH, GLIB
58	Cape May	Cornell Harbor East	39°07'	74°43'	GREG, SNEG, BCNH, YCNH, GLIB
58	Cape May	Cornell Harbor West	39°07'	74°43'	LBH, SNEG, BCNH, YCNH
50	Cape May	Corson's Inlet North	39°13'	74°39'	LT
A80a dmi	Cape May	Cowpens Island	39°17'	74°35'	LBH, CATEG, SNEG, BCNH, GLIB, GBBG, HG
49a	Cape May	Crook Horn Creek	39°14'	74°49'	CT
65a	Cape May	Dead Thorofare	39°02'	74°40'	CT
74*	Cape May	Grassy Sound Channel North	39°01'	74°49'	LG,CT
73*	Cape May	Grassy Sound West	39°02'	74°49'	CT
62	Cape May	Great Flat Thorofare	39°03'	74°48'	GBBG, HG, LG

(Continued)

Table 6 (Continued)

Site No.	County	Name	Latitude	Longitude	Species Present
98B dmi	Cape May	Gull Island North	39°05'	74°46'	LBH, SNEG, LAH, GLIB, HG
98B dmi	Cape May	Gull Island South	39°05'	74°46'	SNEG, LAH, GLIB
59	Cape May	Ingram Thorofare	39°07'	74°44'	BLSK
75*	Cape May	Jenkins Channel	39°03'	74°49'	FT
56*	Cape May	Ludlum Thorofare	39°09'	74°43'	LG, FT
60	Cape May	Muddy Hole	39°04'	74°46'	LG
103 dmi	Cape May	Nummy Island	39°02'	74°48'	GBBG, HG, LG, CT
49*	Cape May	Peck Bay	39°02'	74°37'	LG, CT
68a	Cape May	Reubens Thoro	38°59'	74°52'	CT
61	Cape May	Ring Island	39°03'	74°47'	LG
64	Cape May	Seven Mile Beach	39°02'	74°47'	LT
66	Cape May	Shaw Cutoff	38°59'	74°51'	LBH, CATEG, GREG, SNEG, LAH, BCNH, GLIB, LG
109 dmi	Cape May	Shaw Island	38°59'	74°51'	YCNH, GLIB
A80b dmi	Cape May	Shooting Island	39°16'	74°36'	LG,CT
72	Cape May	South Cape May	38°50'	74°50'	CT, LT
57	Cape May	South Channel	39°07'	74°44'	CT
69	Cape May	S.W. Cove Point	38°58'	74°52'	HG, CT, BLSK
67	Cape May	Stingaree Point	38°59'	74°51'	GREG, LAH, BCNH, YCNH
63	Cape May	Stone Harbor	39°02'	74°46'	LBH, CATEG, GREG, SNEG, LAH BCNH, YCNH, GLIB

(Continued)

Table 6 (Continued)

Site	County	Name	Latitude	Longitude	Species Present
51	Cape May	Strathmere Bay	$39^{o}12'$	$74^{o}40'$	LG, CT, BLSK
98A dmi	Cape May	Sturgeon Island	$39^{o}05'$	$74^{o}46'$	GBBG, HG, LG
68	Cape May	Swain Channel	$38^{o}59'$	$74^{o}51'$	LG, FT, CT
55	Cape May	Townsend's Inlet	$39^{o}08'$	$74^{o}43'$	LBH, SNEG, LAH, BCNH, YCNH, GLIB, HG
70	Cape May	Two Mile Beach	$38^{o}57'$	$74^{o}51'$	LT
85 dmi	Cape May	Weakfish Creek	$39^{o}13'$	$74^{o}39'$	SNEG, BCNH, GLIB
54	Cape May	Whale Beach	$39^{o}10'$	$74^{o}41'$	LT
7	Ocean	Barnegat Head	$39^{o}46'$	$74^{o}07'$	LBH, GREG, SNEG, LAH, BCNH YCNH, GLIB
8	*Ocean*	*Barnegat Inlet*	$39^{o}46'$	$74^{o}06'$	LT
X47 dmi	Ocean	Barrel Island North	$39^{o}34'$	$74^{o}17'$	LBH, SNEG, BCNH, GLIB, CT
X47 dmi	Ocean	Barrel Island South	$39^{o}34'$	$74^{o}17'$	LBH, SNEG, BCNH, GLIB
21*	Ocean	Bunting Sedge	$39^{o}33'$	$74^{o}17'$	CT
5	Ocean	Buster Islands	$39^{o}48'$	$74^{o}06'$	CT
18 dmi	Ocean	Cedar Bonnet	$39^{o}39'$	$74^{o}12'$	LT
9	Ocean	Clam Island Complex	$39^{o}45'$	$74^{o}08'$	GBBG, HG, LG
A35 dmi	Ocean	East Carvel Island	$39^{o}41'$	$74^{o}10'$	HG, CT, BLSK
A43b dmi	Ocean	East Marshelder Island	$39^{o}35'$	$74^{o}14'$	CT
19	Ocean	Egg Island	$39^{o}38'$	$74^{o}13'$	GBBG, HG, LG, CT
40 dmi	Ocean	Flat Island	$39^{o}38'$	$74^{o}12'$	LBH, GREG, SNEG, LAH, BCNH, GLIB, HG
26	Ocean	Good Luck Sedge	$39^{o}33'$	$74^{o}18'$	CT

(Continued)

Table 6 (Continued)

Site	County	Name	Latitude	Longitude	Species Present
27 dmi	Ocean	Goosebar Sedge	$39^{o}32'$	$74^{o}17'$	LBH, SNEG, LAH, BCNH, GLIB, GBBG, HB
11a	Ocean	Gulf Point	$39^{o}44'$	$74^{o}10'$	CT, BLSK
A43a dmi	Ocean	Ham Island	$39^{o}36'$	$74^{o}13'$	CT, BLSK
13*	Ocean	Harvey Sedge East	$39^{o}42'$	$74^{o}10'$	HG
13*	Ocean	Harvey Sedge West	$39^{o}42'$	$74^{o}10'$	HG
9	Ocean	High Bar	$39^{o}45'$	$74^{o}08'$	LBH, SNEG, BCNH, GBBG, HB, LG
20*	Ocean	Hither Island	$39^{o}34'$	$74^{o}17'$	HG
28	Ocean	Holgate	$39^{o}31'$	$74^{o}17'$	CT, LT, BLSK
3	Ocean	Lavallette Island	$39^{o}59'$	$74^{o}05'$	CT
22	Ocean	Little Island	$39^{o}35'$	$74^{o}15'$	HG, CT
A43a	Ocean	Little Ham Island	$39^{o}36'$	$74^{o}13'$	CT, BLSK
15	Ocean	Log Creek	$39^{o}41'$	$74^{o}11'$	CT, BLSK
25	Ocean	Middle Island	$39^{o}34'$	$74^{o}17'$	LBH, GREG, SNEG, LAH, BCNH, GLIB, GBBG, HG, LG
24	Ocean	Middle Sedge	$39^{o}34'$	$74^{o}17'$	HG, LG, CT
1	Ocean	Middle Sedge Island	$40^{o}00'$	$74^{o}05'$	CT
23	Ocean	Mordecai Island	$39^{o}33'$	$74^{o}15'$	CT, BLSK
2	Ocean	N.W. Point Island	$39^{o}59'$	$74^{o}05'$	CT
45A dmi	Ocean	Parker Island	$39^{o}34'$	$74^{o}15'$	LT
A12 dmi	Ocean	Pelican Island	$39^{o}57'$	$74^{o}05'$	LT
16	Ocean	Pettit Island	$39^{o}40'$	$74^{o}11'$	CT
12	Ocean	Sandy Island	$39^{o}43'$	$74^{o}09'$	GBBG, HG

(Continued)

Table 6 (Concluded)

Site	County	Name	Latitude	Longitude	Species Present
11	Ocean	Sloop Sedge East	$39^{\circ}44'$	$74^{\circ}09'$	GBBG, HG
11	Ocean	Sloop Sedge West	$39^{\circ}44'$	$74^{\circ}09'$	GBBG, HG
21a*	Ocean	South Barrel Island	$39^{\circ}33'$	$74^{\circ}16'$	GBBG, HG, CT, BLSK
26a*	Ocean	Story Island	$39^{\circ}33'$	$74^{\circ}18'$	HG
10	Ocean	Vol Sedge East	$39^{\circ}45'$	$74^{\circ}08'$	HG, LG
10	Ocean	Vol Sedge West	$39^{\circ}45'$	$74^{\circ}08'$	HG, CT
14	Ocean	W. Carvel Island	$39^{\circ}41'$	$74^{\circ}10'$	HG, CT
A43b dmi	Ocean	W. Marshelder Island	$39^{\circ}35'$	$74^{\circ}14'$	HG

colony numbers recorded in Figure C2. Some colonies may share the same site number because of their proximity. Figure C2, a map of the specific study area, presents the locations and taxonomic composition of all colony sites. A summary of sites and species in June 1977 is presented in Table 7. Table 8 gives a breakdown of study island species, populations, and nesting substrate.

Census of Colony Sites

125. A total of 52,205 pairs of nesting colonial seabirds and wading birds were censused in June 1977 between Cape May and Manasquan Inlets. Eight species of wading birds, four gulls and four terns, and black skimmer nested in the specific study area. Laughing gulls were the most numerous with 35,241 pairs. Common terns were next with 4,667 pairs, followed closely by herring gulls with 4,202 pairs. Great black-backed gulls and gull-billed terns were rare, but they showed increases over 1976 figures (Appendix A) with 103 and 18 pairs, respectively. A total of 349 pairs of Forster's terns, 691 pairs of least terns, and 1352 pairs of black skimmers were censused. The latter two species have declined in New Jersey and both were unable to successfully produce large numbers of young in 1977. They have both been placed on the New Jersey State Endangered Species List, and steps are being taken to provide extra protection to them at their nesting sites (J. Galli, 1977, personal communication). Wading birds totalled 5,582 pairs, with snowy egrets (2094 pairs), glossy ibises (1543 pairs), and black-crowned night herons (627 pairs) the most numerous. Cattle egrets (431 pairs) were more numerous than great egrets (379 pairs). Little blue herons were more numerous in 1977 than in 1976, with 232 pairs. Louisiana herons and yellow-crowned night herons were least numerous, with populations of 151 pairs and 125 pairs, respectively. Figure 37 indicates the percentage of the total population represented by each species of wading birds.

126. All wading bird species were nesting in mixed colonies in interspecific associations. Least terns were not found nesting in association with any other species. Laughing gulls, while nesting with

Table 7

Colonial Seabird and Wading Bird Census and Survey Results (Cape May to Manasquan Inlet - June 1977)

Species	Breeding Population	# Colony Sites
Little blue heron	232	17
Cattle egret	431	6
Great egret	379	13
Snowy egret	2094	24
Louisiana heron	151	14
Black-crowned night heron	627	28
Yellow-crowned night heron	125	14
Glossy ibis	1543	23
Wading birds (total)	5582	
Great black-backed gull	103	21
Herring gull	4202	40
Laughing gull	35241	31
Gull-billed tern	18	3
Forster's tern	349	6
Common tern	4667	52
Least tern	691	15
Black skimmer	1352	14
Ground nesters (total)	46623	

Total Population: 52,205 pairs

Table 8

Colony Data on Study Islands

Colony No.	Species	Population Pairs	Nesting Substrate
A12	least tern	240	sand, shell, gravel
A35	common tern	160	drift, marsh, grasses
	black skimmer	7	drift
	herring gull	1	grasses
45A	least tern	20	sand, shell, gravel
X27	snowy egret	22	shrubs
	glossy ibis	8	shrubs, reeds
	little blue heron	2	shrubs
	Louisiana heron	2	shrubs
	black-crowned night heron	4	shrubs, reeds
	herring gull	78	grasses, forbs
	great black-backed gull	5	grasses, forbs
A61c	little blue heron	25	shrubs, forbs
	cattle egret	30	shrubs, reeds
	great egret	30	shrubs, reeds
	snowy egret	75	shrubs, reeds
	Louisiana heron	15	shrubs, reeds
	black-crowned night heron	25	shrubs, reeds
	glossy ibis	100	shrubs, forbs, reeds
	herring gull	250	shrubs, grasses, forbs
	great black-backed gull	6	shrubs, forbs, grasses
85 dmi	snowy egret	6	shrubs, reeds
	black-crowned night heron	6	shrubs, reeds
	glossy ibis	4	shrubs, reeds
98A	great black-backed gull	3	grasses, reeds, shrubs
	herring gull	40	grasses, shrubs, reeds
	laughing gull	12	saltmarsh
98B North	little blue heron	4	trees, shrubs, reeds
	snowy egret	100	trees, shrubs, reeds
	Louisiana heron	2	trees, shrubs, reeds
	glossy ibis	75	trees, shrubs, reeds
	herring gull	20	grasses, shrubs
98B South	snowy egret	120	trees, shrubs, reeds
	glossy ibis	20	trees, shrubs, reeds
	Louisiana heron	1	trees, shrubs, reeds

(Continued)

Table 8 (Concluded)

Colony No.	Species	Population Pairs	Nesting Substrate
103	great black-backed gull	20	shrubs, reeds, grasses, forbs
	herring gull	400	shrubs, reeds, forbs, grasses
	common tern	32	saltmarsh drift
	laughing gull	950	saltmarsh
109	yellow-crowned night heron	20	trees, shrubs, reeds
	glossy ibis	4	trees, shrubs, reeds

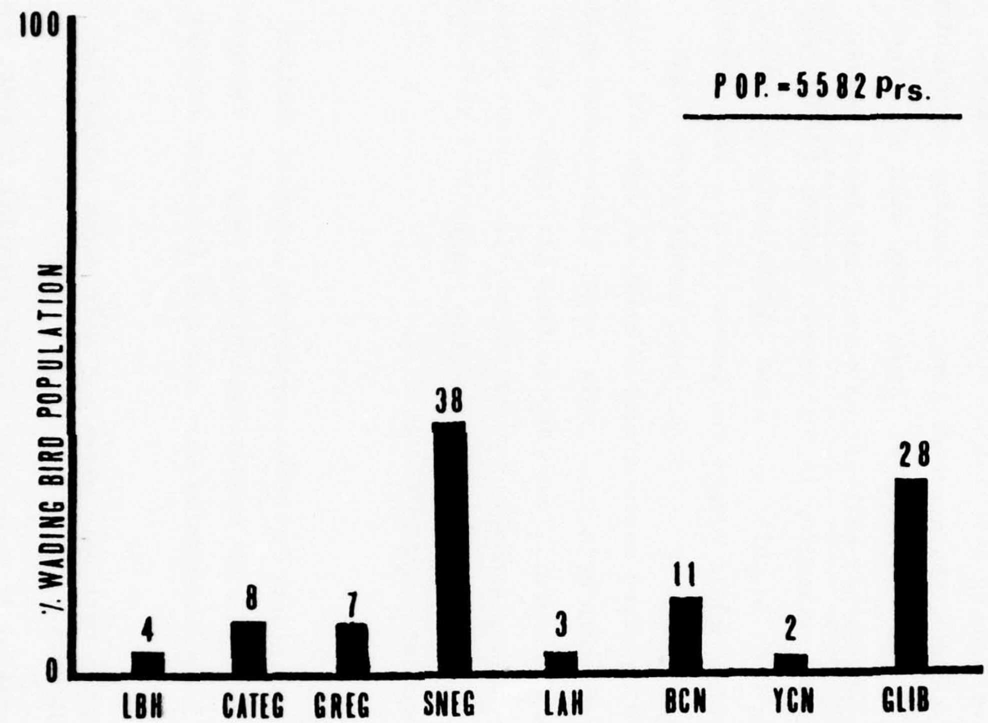

Figure 37. Wading bird species population distribution, showing percentages of species in the total New Jersey population. LBH= little blue heron; CATEG= cattle egret; GREG= great egret; SNEG= snowy egret; LAH= Lousiana heron; BCN= black-crowned night heron; YCN= yellow-crowned night heron; GLIB= glossy ibis

other breeding species (common terns, Forster's terns, herring gulls) nearby, did not form any positive nesting associations with other species: their proximity seemed to be more a function of nest site habitat than anything else. Black skimmers and common terns did seem to have a nesting site association, with common terns nesting at 13 of the 14 black skimmer sites. Herring gulls and great black-backed gulls also showed a positive nesting association at all 21 colony sites. Herring gulls seemed to show the greatest range in nesting associations and habitat tolerance. They occurred at colony sites with all other species except Forster's terns, gull-billed terns, and least terns. Herring gulls are rapidly expanding in New Jersey (Burger 1977b) and are heavily competing with laughing gulls and common terns for nest sites (Burger and Shisler 1977; Burger and Lesser 1976). They arrived earlier at their nest sites than other species, except great black-backed gulls,and were observed successfully preying on eggs and young in nearby heronries and tern colonies. Only great black-backed gulls seemed to be able to successfully out-compete them for higher, drier nesting spots in the marsh, probably by nesting earlier. Great black-backed gulls were more advanced in their nesting stages by 1 to 2 weeks, and most had well-developed young by June 1977.

General colony habitat

127. The general colony habitats supporting colonial nesting wading birds and seabirds in New Jersey were placed into 10 categories listed in Table 1. These categories were combined into four broader categories.

a. Marsh includes both salt marsh and salt marsh island for further analysis.

b. Dredged Material includes all dredged material islands, marsh islands with dredged material deposition, and salt marshes with dredged material deposition.

c. Barrier Island includes barrier spits as well as barrier islands.

d. Other refers to construction fill sites or natural sand shoals.

Table 6 summarizes the types of nest sites utilized by the species studied in June 1977.

128. Figures 38 through 47 indicate the species population and colony site distribution over four general colony habitat categories. Figure 38 shows that 47 percent of the total number of colony sites were found in marsh habitat, but 38 percent were located on dredged material sites. When the total breeding population which includes very large numbers of laughing gulls, herring gulls, and common terns (Table 7) is considered (Figure 39), the marsh habitat was clearly the most utilized, with 76 percent of the total population nesting in marsh and only 18 percent on dredged material. In both cases the barrier island habitat was the least utilized. Analysis of the breeding population by species gives a more precise picture of the importance of each type of habitat.

129. The wading birds did not utilize marsh habitat at all. During the 1800's they nested in very large colonies on the then-wooded barrier islands. Figures 40 and 41 show that dredged material islands are now the most important habitat for heronry sites. Seventy-one percent of the wading bird population and 75 percent of their colony sites were located on dredged material sites. Barrier islands retain some importance, since 28 percent of their population and 22 percent of their colony sites are located there. One colony is located on construction fill near Atlantic City.

130. The importance of dredged material islands as colony sites for wading birds is further supported by closer analysis of the individual heron species population and colony site distributions. In all species, at least half their colony sites were located on dredged material (Figure 42), though barrier islands were also important. The population distribution levels were similar to colony site distribution, although barrier island colonies supported greater populations of certain species (great egrets, black-crowned night herons, yellow-crowned night herons) than the other sites. However, dredged material colony sites supported 91 percent of the snowy egret, 75 percent of the glossy ibis and 68 percent of the little blue heron populations (Figure 43).

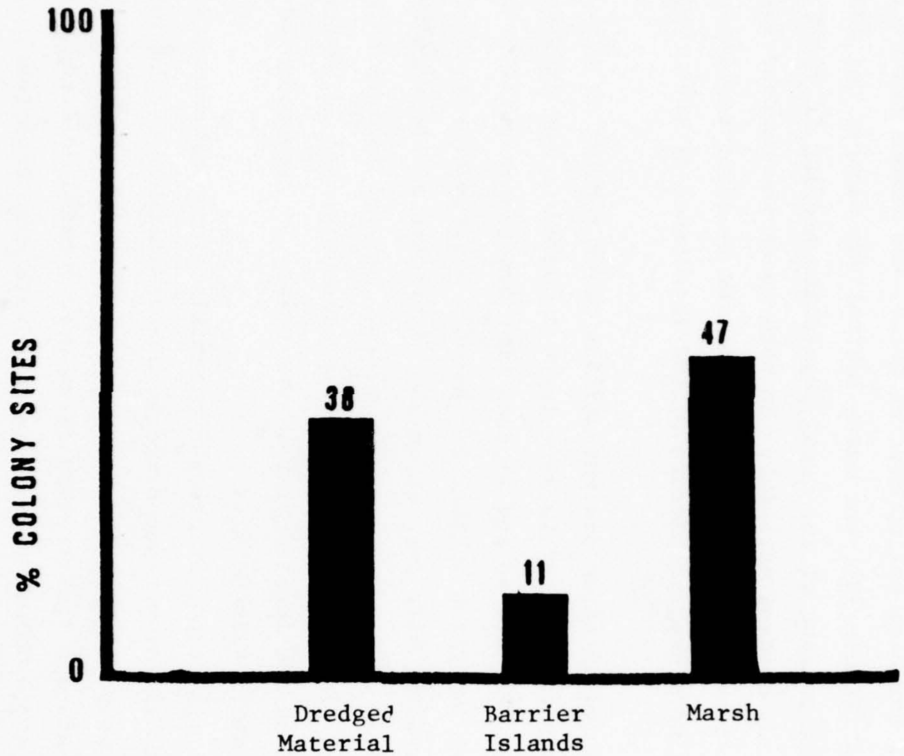

Figure 38. Colony site distribution, showing percentages of total sites on three different habitats

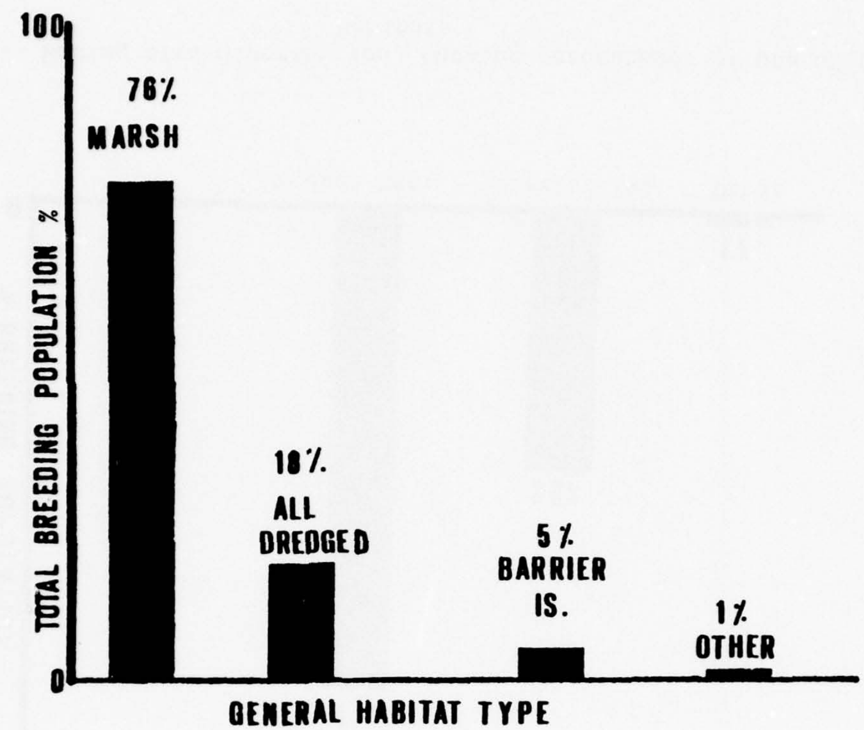

Figure 39. Population distribution of colonial waterbirds in New Jersey, showing percentages using four different habitats

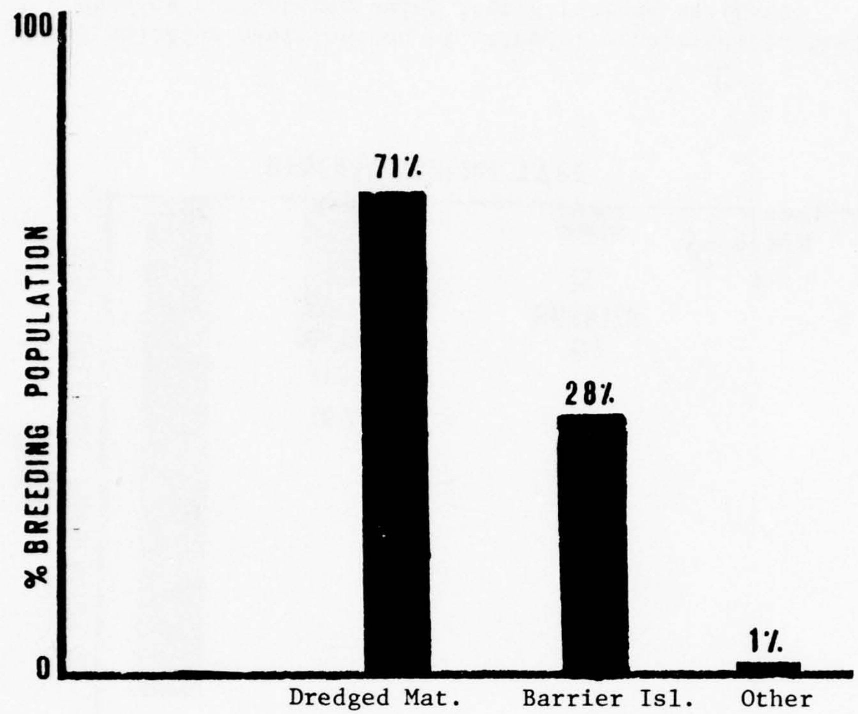

Figure 40. Wading bird distribution, showing percentages of use of three habitats

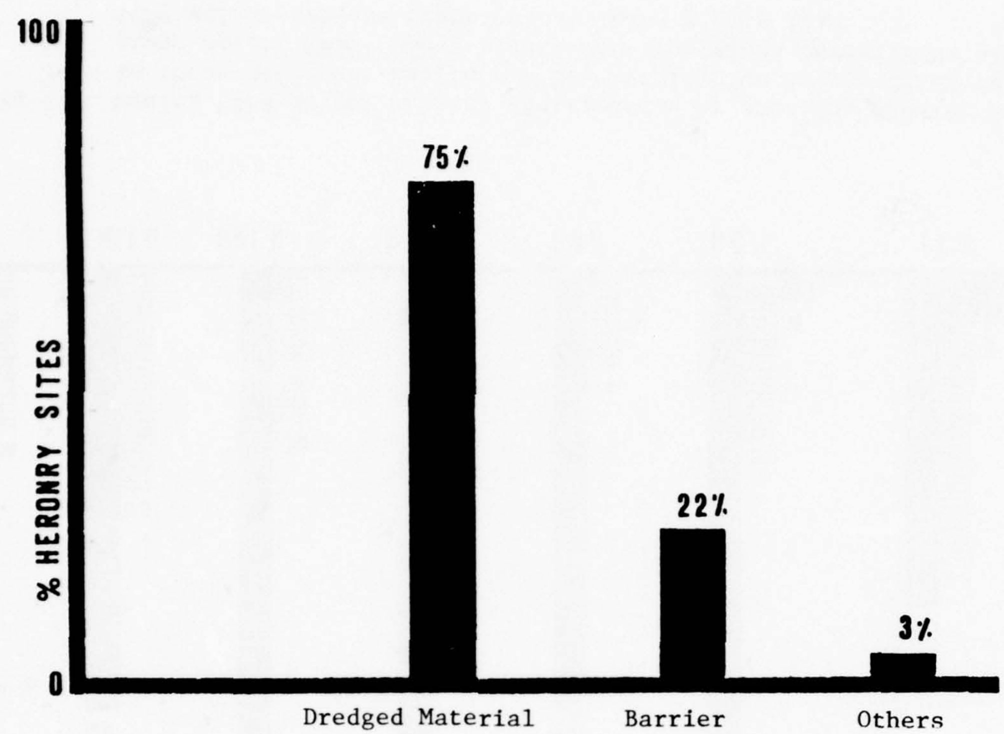

Figure 41. Wading bird colony distribution, showing percentages of colonies occurring on three different habitats

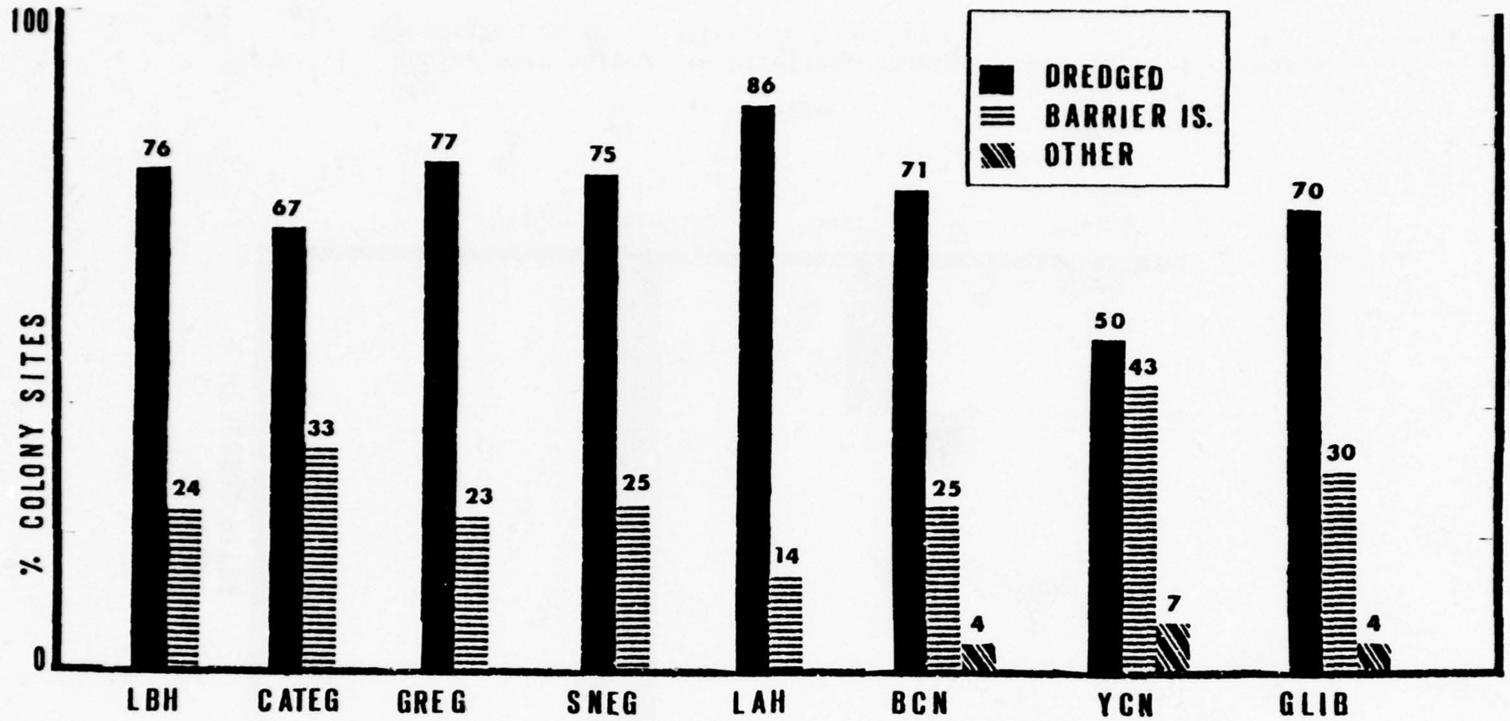

Figure 42. Wading bird colony habitat distribution by species, showing percentages of colonies in three different habitats. LBH=little blue heron; CATEG=cattle egret; GREG= great egret; SNEG= snowy egret; LAH= Louisiana heron; BCN= black-crowned night heron; YCN= yellow-crowned night heron; GLIB= glossy ibis

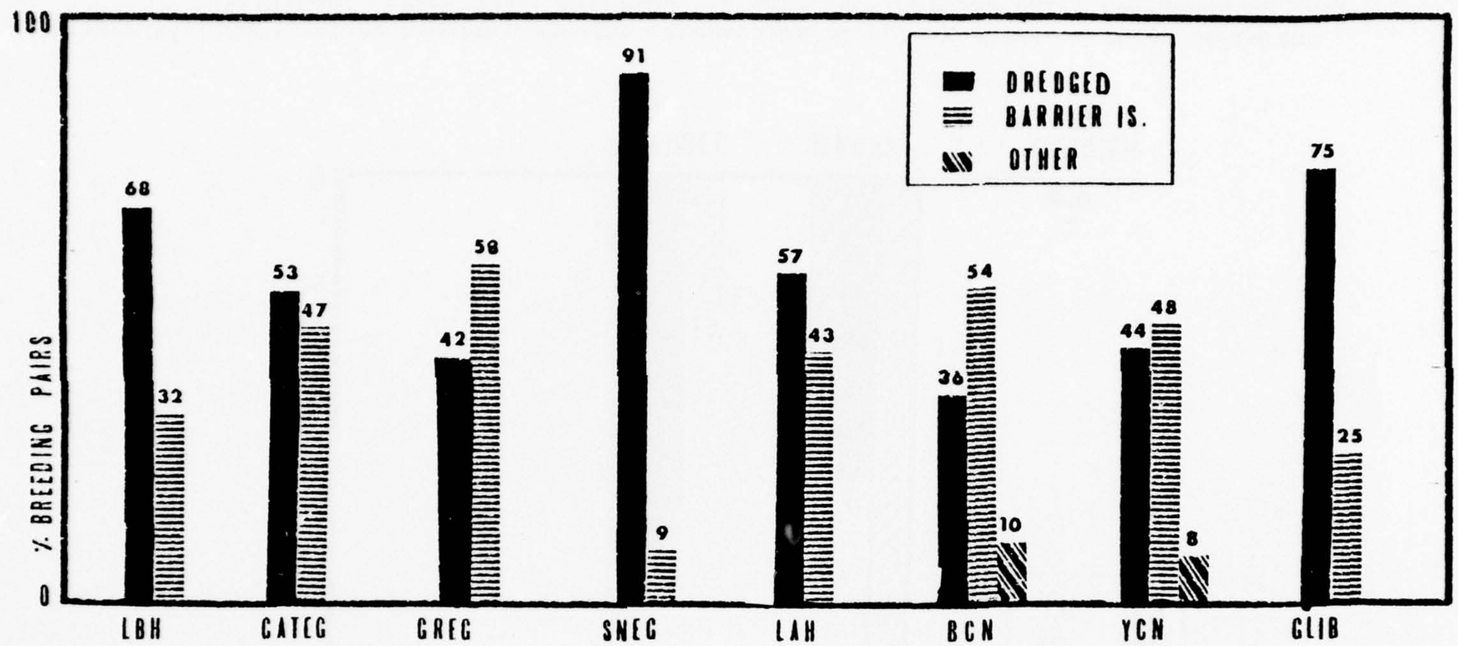

Figure 43. Wading bird species distribution by colony habitat, showing percentages of breeding pairs. LBH= little blue heron; CATEG= cattle egret; GREG= great egret; SNEG= snowy egret; LAH= Louisiana heron; BCN= black-crowned night heron; YCN= yellow-crowned night heron; GLIB= glossy ibis

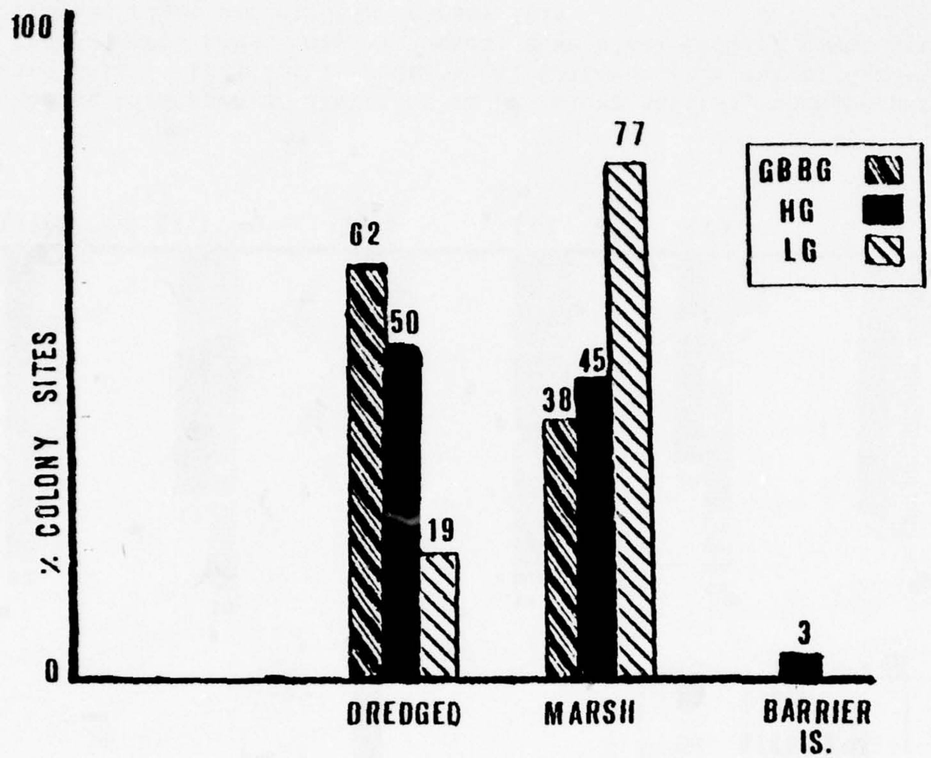

Figure 44. Gull colony habitat, showing percentages of colony sites on three different habitats. GBBG= great black-backed gull; HG= herring gull; LG= laughing gull

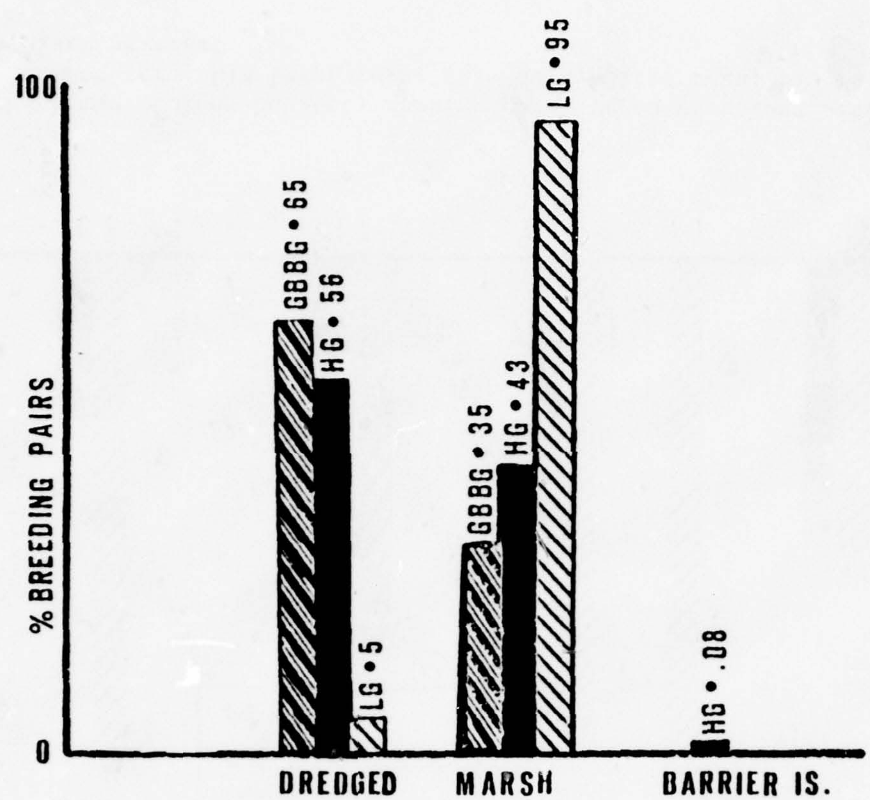

Figure 45. Gull species distribution by colony site habitat, showing percentages of all three gull species use of three different habitats. GBBG= great black-backed gull; HG= herring gull; LG= laughing gull

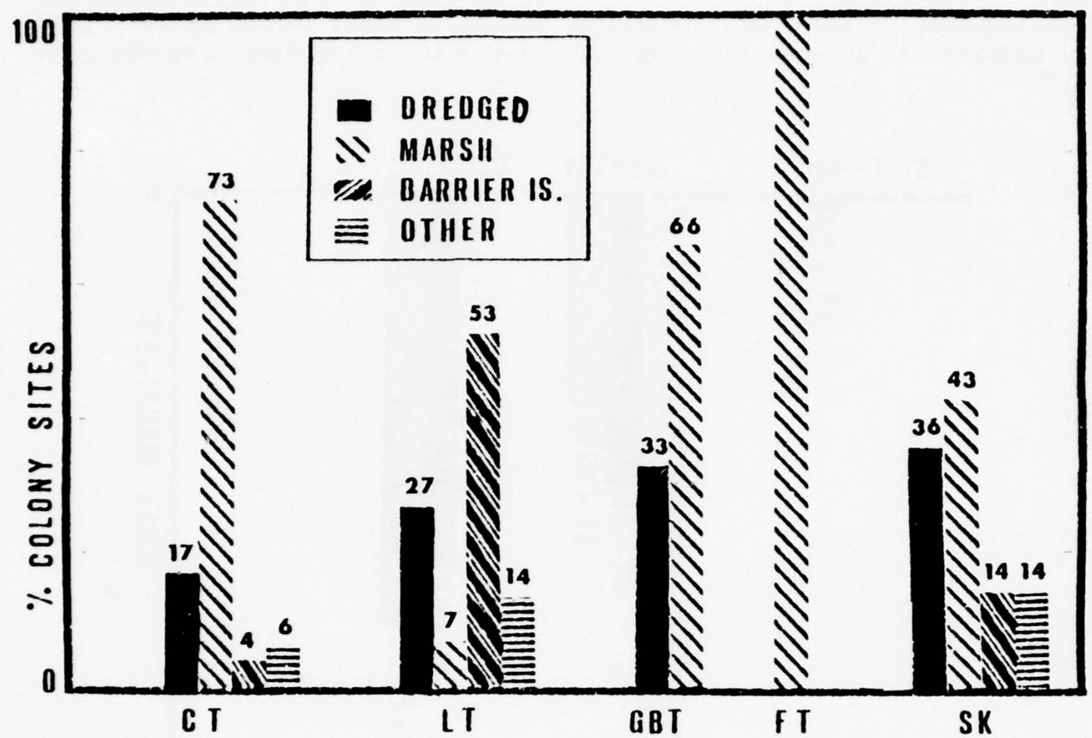

Figure 46. Tern-skimmer colony habitat, showing percentages of colony sites by species. CT= common tern; LT= least tern; GBT= gull-billed tern; FT= Forster's tern; SK= black skimmer.

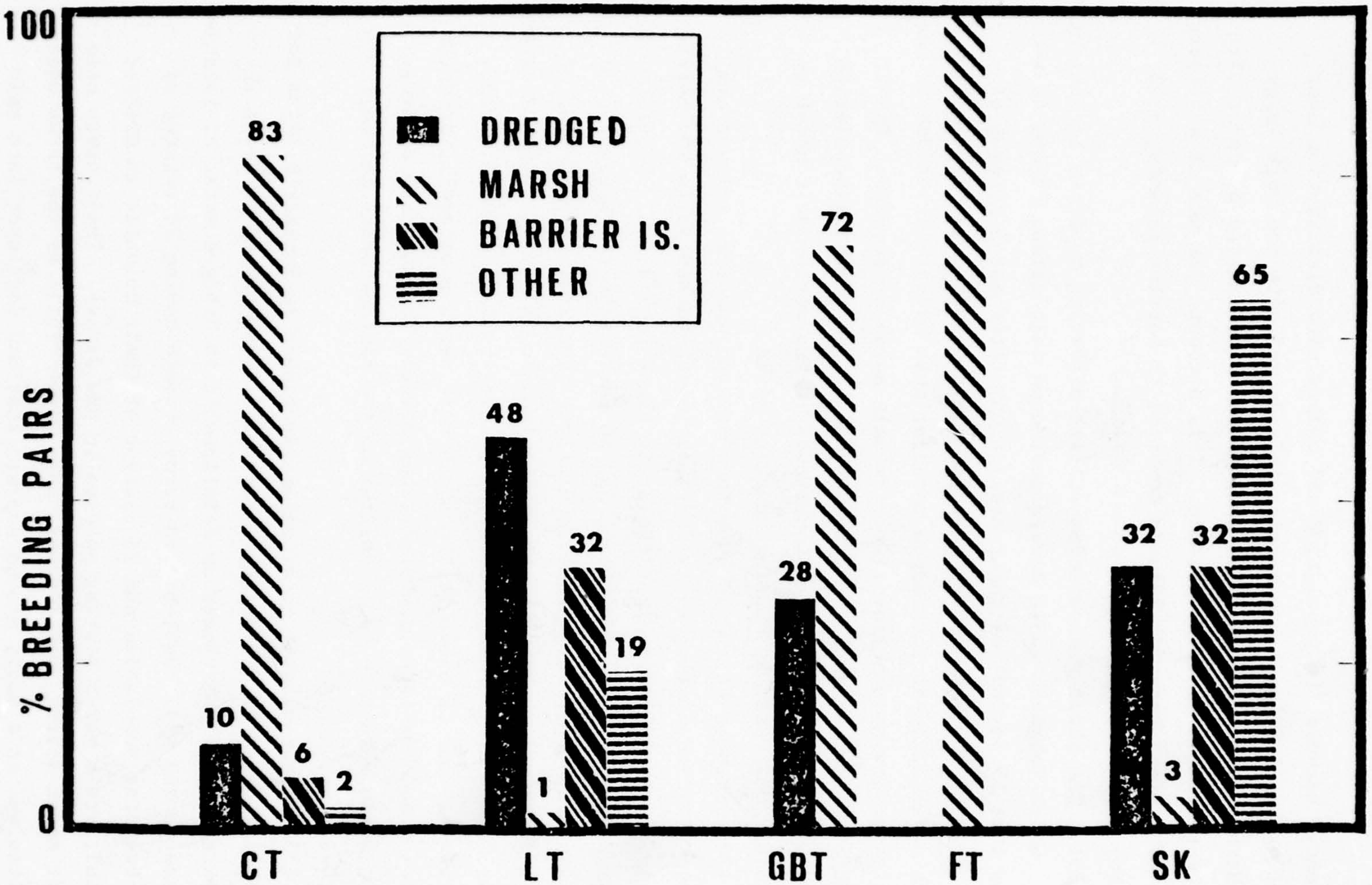

Figure 47. Tern-skimmer species distribution by colony site habitat, showing percentages of breeding pairs by species on four different habitats. CT= common tern; LT= least tern; GBT= gull-billed tern; FT= Forster's tern; SK= black skimmer

Differences between the population and colony site distribution over dredged material islands and barrier islands reflects the very large Stone Harbor heronry compared to smaller colonies limited by cover size on younger dredged material islands. This accounts for use of a greater number of dredged material islands compared to barrier islands, with shrinking available habitat.

131. The three gull species utilize differing habitats for colony sites. While laughing gulls always nested on salt marsh, Figure 44 and 45 show that 19 percent of their nest colony sites and 5 percent of their breeding population were associated with dredged material, either on salt marsh adjacent to dredged material that had either eroded or been deposited at low enough elevations for salt marsh to develop. The 77 percent of colony sites and the 95 percent of the breeding population on natural salt marsh leave no doubt that in New Jersey salt marsh is the habitat most used by nesting laughing gulls.

132. Figures 44 and 45 show that dredged material islands are the most utilized nesting sites for great black-backed gulls and herring gulls,supporting 62 percent of the great black-backed gull colonies with 65 percent of the population, and 50 percent of the herring gull colonies with 56 percent of the population. Despite the expansion of herring gulls and great black-backed gulls into salt marsh nesting areas (Burger 1977) and the adaptability of herring gulls to a wide variety of habitats, most of those in the marsh were nesting on small, dredged material mounds on the sides of ditches dredged for mosquito control. Herring gulls were also found nesting on the barrier beach in small numbers.

133. Marsh habitat is of major importance to Forster's terns and gull-billed terns in New Jersey. Forster's terns nested on drift in salt marsh areas, and showed no relationship to dredged material islands (Figures 46 and 47). Gull-billed terns, though having 28 percent of their breeding population and 33 percent of their colonies on dredged material, are a marsh nesting species in New Jersey. Their nests were on salt marsh drift. One (Oyster Thoro Marsh {#61}) of the three nesting sites was on a badly eroded deposit that had developed into salt

marsh.

134. Common tern colonies and breeding pairs were also predominantly found in marsh habitat. Figure 46 shows that 73 percent of their colony sites were located in marsh habitat and natural sand shoals on dredged material. Barrier island habitat and natural sand shoals account for a small portion (10 percent) of the 52 sites. Population numbers (Figure 47) show that marsh habitat is very important in New Jersey, with 83 percent of the common terns on marsh and only 10 percent associated with dredged material. Barrier island habitat accounted for only 6 percent of the population. The major portion of colony sites were on salt marsh grasses and drift including those on dredged material islands.

135. Least terns nested on dredged material islands, on barrier islands, on sand shoals, and on mainland sandy beach, with 53 percent of their colony sites on barrier island beaches (Figure 46). Dredged material was used by 27 percent of their colonies. Sites noted as marsh in Figure 46 were actually sandy areas in marsh behind the barrier beach. Population distribution data, however, showed some differences in habitat utilization from colony site data. Dredged material sites were used by 48 percent of the population, with barrier islands being used by 32 percent. The differences between colony site and population percentage distributions over habitat types reflects the presence of a large colony on dredged material Study Island A12, which supported the largest least tern colony in New Jersey in 1977.

136. Black skimmers nested on dredged material sites, marsh, barrier islands, construction fill, and natural sand shoals. Figures 46 and 47 show that barrier islands supported 14 percent of the colonies and 32 percent of the population. Dredged material sites were also important, having 36 percent of the colonies and 32 percent of the population. Comprising only 14 percent of the colonies, two sites held 65 percent of the population: one on construction fill and another on a natural sand shoal. Each site supported large populations (400 and 450 pairs, respectively). Nesting black skimmers associated frequently with common terns, even in salt marsh colonies, though in small numbers. In

1977, 42 pairs were located in marsh colonies with common terns. Their nests were on salt marsh drift rather than the sand and shell usually associated with skimmers.

Comparison of Vegetation on Study Islands with and without Bird Colonies

137. Analysis of data indicated that there are no significant differences of average frequency, cover or height scores, and visibility indices between bird (colony) and vegetation (non-colony) dredged material islands. Reed, reed-shrub, shrub, dense grassland, shrub-dense grassland, and shrub-forest habitats were found on study islands in New Jersey in greater numbers and distributions in bird colonies. They are probably the most important plant communities on the study islands.

138. In comparisons of hectares of habitat on all bird islands vs. all vegetation islands, only bare habitat occurred in significantly greater size and percentages on bird study islands. Adequate bare-sand habitat usually favored by least terns, common terns, black skimmers, and to a lesser extent by herring gulls, is very scarce on dredged material islands along the New Jersey Intracoastal Waterway. These species are forced to nest in probably marginal habitat such as drift.

139. Other analyses showed no significant differences between plant communities with or without colonies.

PART IV: DISCUSSION

140. Numerous dredged material sites exist between Cape May Inlet and Manasquan Inlet. Of these, at least 25 sites supported colonial nesting seabirds and/or wading birds. The dredged material sites were not all discrete islands: some were areas of marsh that had dredged material deposits and some were large diked areas connected to land. They ranged in size from 1.6 ha to 129.3 ha and in known age from one to at least seventeen years. Although dredging has caused island formation in New Jersey for at least 75 years, dates of deposition are unknown. The 21 dredged material study islands ranged in size from 0.6 to 4.0 ha and in age from 1 to 14 years. Only three of the study islands were diked. The diking of dredged material disposal sites is currently the only method of disposal permitted in New Jersey, and these three sites had the most recent dredged material depositions of those studied.

141. Vegetation on the islands ranged from none (bare sand or sand/shell/gravel), to salt marsh grasslands, to upland grasslands, to developing shrub and shrub-forest communities. Colonial nesting waterbird species were found in most of the plant communities as well as on bare sand. Data indicated that other factors besides age of the dredged material site greatly influenced the plant succession patterns presently found at the study sites.

Plant Succession

142. Dredged material islands provided a wide range of habitat and exhibited all stages of vegetation common to the barrier beaches and salt marsh areas of the outer coastal plain of southern New Jersey. Their deposition on tidal salt marsh provided upland vegetation with conditions favorable to growth in places where previously there had been none. In some instances marsh areas were increased by the sediment deposition in shallow waters. In other areas, preexisting salt marsh was destroyed and the resulting upland habitat was then claimed

by large stands of common reed. Vegetation and successional patterns on the dredged material study sites seemed to conform fairly closely to vegetation communities and successional patterns already described by Martin (1959), Chapman (1960), Robichaud and Buell (1973), and Daiber (1974) for the salt marshes and barrier islands of southern New Jersey.

143. Early seral stages were represented by bare, sparse grassland, dense grassland, and reed habitat. Species tolerant of saline and marsh conditions tended to be the colonizing or pioneering types. Mid seral stages were typified by young reed-shrub and shrub-dense grassland communities. Late seral stages were characterized by shrub and shrub-forest communities which occurred on the higher upland portions of older dredged material islands not subject to periodic flooding and lacking high soil salinity.

144. Early seral stages were found on islands varying in age from one year to at least 12 years old (deposition from 1965-1976). Mid seral stages were found on deposits 9 to 14 years old (deposition 1963-1968). Dredged material islands utilized from 1963-1966 (11 to 14 years old) exhibited late seral stage vegetation. Only the diked study islands had a single seral stage present. The others showed a combination of seres in diverse patterns. Factors other than age also influence successional stages found on these islands and probably account for variation between age and overlapping seres found on study islands. Martin (1959), studying vegetation at nearby Island Beach, found that vegetation types and patterns correlated closely with topography. He found that soil condition, salt spray distribution, salt spray tolerance, and water table levels also influenced vegetation and succession patterns, though he considered them to be subordinate to microtopographical effects. Daiber (1974) believes that tidal inundation, water levels, and salinity are of prime importance in determining vegetation patterns in salt marsh areas.

145. All these factors played a role in determining the varied and overlapping communities found on the study islands and the early stage vegetation exhibited on many islands despite their age. Martin (1959) attributed the stability and persistence of pioneer communities

in the most extreme habitats of xeric, mesic, and hydric zones to the inhibition of autogenic succession by physical factors, especially salt spray. Bare domes, extensive salt marsh vegetation, storm tide flooding, and dead vegetation found on many of the older study islands supports some of these factors as causes for the lack of correlation between seres and age. Investigation of the role played by these factors is needed over a longer period to determine the major influences on succession on dredged material islands in New Jersey.

Plant Comparisons Between Study Islands with and without Colonies

146. Dredged material study islands were remarkably similar in all parameters measured. No significant differences in vegetation frequency, cover, or height were found for any of the plant communities. Visibility indices derived for study islands also showed no significant differences. The qualitative occurrence of communities across all study islands and across pooled vegetation islands. Study islands with bird colonies did have a uniform distribution of plant communities when their data were pooled. Some communities were disproportionately represented on the bird study islands (reed, reed-shrub, shrub, and shrub-forest), probably due to the preponderance of bird study islands supporting heronries that were selected for study. The paucity of bare habitat along the New Jersey Intracoastal Waterway made it the most critical habitat to provide for nesting.

147. Heron colonies did not differ among themselves in proportional representation of plant communities. Herring gulls were heterogeneous with respect to their use of plant communities for nesting across all study islands. Heron density, deposit size, and deposit age comparisons showed no significant differences.

148. Other factors (not determined in this study) are of real importance in the selection of dredged material islands as nesting sites by colonial seabirds and wading birds, once minimal plant community habitat requirements are met.

Bird-Plant Associations

149. The plant communities occupied by nesting birds on dredged material study islands are summarized in Table 9. Examination of the plant communities present on the study islands shows that correlation of nesting birds to sere is difficult because of the presence of several communities. Only least terns showed a decided preference for a single seral stage, nesting in bare and sparse grassland communities. Least terns were found at only two study sites (45A and A12), but observation of other colony sites in the study area indicated that the sparse grassland on A12 was the most densely vegetated nesting situation.

150. The only common tern colony on the study islands occurred on the largest aggregate of dense grassland/drift communities found on all study islands, although the colony included intertidal, reed, reed-shrub, shrub-dense grassland, and shrub communities within its boundaries as well. Observation of other colony sites indicated that salt marsh drift and sand were frequently used as nest sites in the study area. Black skimmer data are limited since they occurred on the same study island (A35) with the common terns and only on salt marsh drift, an unusual nesting habitat for skimmers.

151. Herring gulls were the most diverse in their choice of colony habitats. Colonies on five study islands (X27, A61c, 98A, 98B North, 103) exhibited the widest range of plant communities within colony boundaries of all species studied. Communities representative of early, mid and late seral stages were included. Their wide choice of nesting habitat and expanding population made establishing preferences based upon study island colonies difficult. Despite the presence of 23 pairs of great black-backed gulls within four of the study island gull colonies (103, 98A, A61c, X27) in 1977, their habitat preferences could not be determined. Nesting chronology was too advanced when first observed.

152. The herons showed a definite preference for the reed, reed-shrub, shrub, and shrub-forest communities. The extensive stands of common reed, and the adaptability of certain wading bird species (glossy

Table 9

Plant Communities on Study Island Colony Sites

Species	Community	No. Colony Sites
Herons*	P	3
	PS	5
	S	4
	SF	3
Herring gulls	I	1
	B	1
	D	1
	GD	2
	P	2
	PS	2
	SGD	1
	S	3
Common terns	Drift	1
	I	1
	P	1
	PS	1
	SGD	1
	S	1
Least terns	B	1
	GS	1
Black skimmers	Drift	1

* includes herons, egrets, ibises

B = bare; I = intertidal; D = dike; GD = dense grassland; GS = sparse grassland; SGD = shrub-dense grassland; S = shrub; P = reed; PS = reed-shrub; SF = shrub-forest

ibis, snowy egret, black-crowned night heron) made the wading bird population associated with early, mid and late seral stage vegetation at the six study island colonies. Use of reed for nesting at three colonies should not be regarded as an indication of the desirability of it as a heron nesting habitat. Colony site data showed that while some nests were in reed, many nests were found on woody shrubs (often only 1.5 m high) scattered through the reed. The developing shrub and shrub-forest communities on many of the older dredged material sites in New Jersey offer future wading bird populations numerous colony site choices compared to the scarcity of the bare sand habitats available for tern and skimmer populations.

153. The other colonial seabird species (laughing gull, Forster's tern, and gull-billed tern) nested in salt marsh habitats, most often upon drift, and were not often associated with the study islands.

Bird Effects Upon Plants

154. The effects that colonial bird species have upon vegetation at their colony sites have been studied by other researchers (Weise 1978, Burger 1976, Soots and Parnell 1975a and 1975b, Shanholtzer 1974, Ranwell 1972). Wiese (1978) found that extensive areas of a large mixed species heronry on Pea Patch Island, Delaware (a dredged material island colony that probably acts as a seed colony for several of the New Jersey heronries), were destroyed or defoliated by guano deposition by the birds during 1975 and 1976. The vegetation most affected was blueberries (*Vaccinium* sp.), though all herbaceous ground cover was also destroyed. The following season there was an invasion of nitrophilous species such as bluestem and elderberry, and nesting density was greatly decreased because of the loss of the preferred shrub for nesting locations. Weise also found that the birds' mechanical destruction of the vegetation in nest construction added to the defoliation of vegetation at site. Miller (1943) refers to the effects upon vegetation of great blue heron excrement, noting that red maple (*Acer rubrum*) seemed particuarly sensitive at colonies in Salem County, New Jersey.

155. Observations in 1977 at wading bird colony sites in New Jersey did not indicate extensive damage as described by Wiese (1978) but dead and/or bare vegetation, particularly in the understory at barrier island sites, was noticeable. Dredged material sites showed less damage, although vegetation used for nesting was younger and of slightly different species composition and dominance than the well-developed maritime forests common in barrier island colonies. The wading birds' greatest long-tern influence on vegetation growth patterns is probably through fecal enrichment of the soil.

156. Fecal enrichment of colony substrates has been noted in Europe where plant growth on normally open dune areas was changed by gulls into a "lush carpeting growth of weed species" (Ranwell 1972). The gulls also aided seed transport by carrying seeds in pellets regurgitated at the nest site. Burger (1976) found that black-headed gulls (*Larus ridibundus*) in England influenced the growth of nettles (*Urtica* sp.) tolerant to high nitrogen levels at colony sites over the native grasses preferred by the gulls. Soots and Parnell (1975a and 1975b) studied the changes in vegetation due to fertilization of North Carolina colony sites by royal terns (*Sterna maxima*), black skimmers, gull-billed terns, and common terns. This effect was suspected in New Jersey at the least tern colony on Island A12 (also a colony in 1976). The sparse vegetation growing on the dome slopes was probably encouraged by the fertilizing effects of the colony. Presence of a large least tern colony in an area as densely vegetated as this is unusual, and the site will probably not be suitable much longer for least terns.

157. Vegetation trampling and compression at colony sites has also been noted by several authors (Burger 1976, Soots and Parnell 1975a and 1975b, Shanholtzer 1974). The movement of many birds in and out of the same area and the placement of nests compresses the vegetation and retards its growth. This effect was most noticeable in the gull colony on Island 98A, where runways through the taller grasses between nest sites and an open grassy area used for loafing and maintenance activities were quite obvious. The physical damage to vegetation by nest-building activities, where plants are mechanically destroyed by

being trampled, by being pulled down and woven into a nest platform, or by being broken off at their stems and/or uprooted, can also have devastating effects upon the establishment of vegetation at colony sites.

158. The colonial species studied at the dredged material sites are probably not major seed vectors between islands and the mainland. However, they could influence seed dispersal of some species by carrying seeds in plumage or other body parts and disseminating them during maintenance activities that are often performed away from nests sites.

PART V: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

159. A complete inventory of dredged material island locations, origins and ages is needed in New Jersey. Repeated deposition of dredged material over the years on New Jersey salt marshes and islands, the irregularly shaped and eroding deposits, the overlapping plant communities and seral stages, and large stands of common reed all made correlation of plant seres with the age of study islands essentially impossible. Data indicated that other unstudied factors such as island microtopography would have been more useful in determining plant successional patterns. Dredged material islands in New Jersey do not fit the concentrically zoned bands found by Soots and Parnell (1975a, 1975b) in North Carolina, and Carlson (1972) in Florida. Instead, they present mosaic patterns similar to those described by Martin (1959) for Island Beach, NJ, and Ranwell (1972) for dune and salt marsh communities in these situations and should be the subject of future investigations. Microtopography, water table levels and salinity, salt spray tolerance, tidal flows, soil salinity, and species composition are among the factors that should also be considered.

160. Few significant differences were found between vegetation communities and their distribution on dredged material study islands with and without bird colonies. However, bare sand habitat was more common on bird study islands. Little new information was gained from the bird-vegetation associations studied beyond that already available in the general literature, especially for southern New Jersey (Appendix A).

161. There is little doubt that dredged material islands are important colony sites for wading birds and seabirds in New Jersey. The increasing development of barrier islands, resulting in habitat loss and disturbance, mandate the use of alternative colony sites by colonial nesting species. Dredged material islands can provide and are providing needed habitat alternatives for these species. Management of

these island sites in a manner designed to encourage the presence of desired wildlife species must be carried out if New Jersey is to maintain any semblance of once abundant and rich coastal wildlife resources.

Recommendations

162. Management recommendations made here, while formulated with specific reference to New Jersey dredged material islands, may also have broader applicability, especially in other estuarine areas where dredged material island management to provide and protect wildlife resources is desirable. The following recommendations are based upon investigations in New Jersey for this study, but are also based in part upon prior experience and investigations elsewhere along the Atlantic Coast.

General recommendations

163. The following recommendations are not necessarily listed in order of importance. They should be considered individually and together to provide a cohesive and practicable management program. They are:

a. Inventory of dredged material islands. A complete investigation of dredged material island locations, origins, and ages based upon scientific methods such as coring, is needed in New Jersey. County historical records, title deeds, and historical navigation records should also be investigated as possible sources of information. Ownership should also be determined so that permission could be sought for management procedures, if necessary.

b. Timing of dredged material deposition. The nesting season in New Jersey for colonial species extends generally from mid-March through 31 August and sometimes to late September (especially for black skimmers). Efforts should be made to carry out dredging operations during non-nesting times.

c. Wildlife survey of dredged material sites. Before any dredging is begun, a survey of the disposal area should be made to determine the location of any nesting bird species. If colony sites are located at planned disposal areas, dredging should be delayed until after the nesting season, or an alternate site should be used.

d. Contractor monitoring. Once choice of a disposal site is made, careful and frequent onsite monitoring should be made to ensure that (1) the site being deposited upon is actually the designated location; (2) proper procedures are being used so that overspills and dike breakages are prevented, or are immediately corrected if they occur; (3) colonial nesters have not selected the site for nesting between the time of site designation and onset of dredging.

e. Record keeping. Careful records should be kept of all dredged material disposals, with dates, location, configuration, area covered, quantity, and sediment composition noted.

f. Integration of inlet dredging with Intracoastal Waterway dredging. Badly needed clean sand is often dredged from inlets. Use of this sand on dredged material islands in areas along the Intracoastal Waterway where contaminated or undesirable fines and clay sediments are dredged and deposited would be beneficial. The clean inlet sand could be used to cover the less desirable sediments, thereby providing useful and productive wildlife habitat.

g. Cooperation with other agencies. The interests of many other Federal, State, and local agencies are affected by the dredged material disposal activities of the Corps of Engineers. Mutual aid and information exchange at both national and local levels between all mutual interest groups are necessary before any management program can be effective. The sharing of expertise and genuine cooperative efforts for the formulation of an ecosystem-wide management plan for dredged material islands would benefit all, especially the wildlife. Environmental interest groups such as National Audubon Society and researchers should be included in any management planning so that all viewpoints would be considered.

h. Educational programs. An educational program should be instituted to acquaint key people at both the national and district levels with the wildlife value (potential and present) of dredged material islands and the consequences of less-than-careful dredged material disposal practices, especially upon species utilizing these sites during breeding seasons. Potential problems, solutions, and minimal operational changes (such as delaying disposal activities until after the breeding season) should be emphasized. An effort should be made to acquaint dredging contractors with potential wildlife resource problems as well. Organizations and personnel preparing environmental impact statements should be provided with data so that they are aware of the multiple wildlife use of these sites. Ecological awareness should also be encouraged.

i. Research needs. This study investigated the use of dredged material islands only by colonial wading birds and seabirds for only one field season. Before any active general management plans can be effected, more data must be made available to determine patterns of use of these islands by these and other species and under varying conditions. These islands are used by many bird species and other vertebrate and invertebrate groups, not only for breeding but for feeding, loafing, and roosting. The year-round use patterns by wildlife have not been studied and are essential knowledge for intelligent land use planning. Much remains to be learned about wildlife use of dredged material sites in New Jersey and an ongoing research program should be part of any management plan.

Colonial wading bird/seabird management recommendations

164. The following management recommendations are concerned with the needs of colonial wading bird and seabird species in New Jersey and are not necessairly listed in order of importance. They are:

a. Colonial waterbird survey. An annual survey of dredged material sites should be made to locate nesting colony sites before any dredged material disposal operation. In New Jersey, the optimal time for this survey would be in mid-May, when wading bird and gull nesting is well underway and terns are on their nest sites.

b. Deposition on colony sites. Dredged material disposal on colony sites during the nesting season is unlawful and in violation of numerous Federal and State wildlife protection regulations. If deposition must be made on a known colony site because no other alternative is available, or wildlife management practices require it, it should be done before or after the nesting season.

c. Habitat survey. A habitat survey should be made of the dredged material islands along the New Jersey Intracoastal Waterway on an annual or biennial basis to determine the proportions of habitat types available to all colonial species. Locations of bare sand habitat are needed most to manage early and early-mid seral stages. Islands with late seral stage vegetation suitable for wading bird colonies should be noted and managed for use by these species. Once needs are determined, deposition of uncontaminated sand/shell/gravel dredged material should be made at the proper time and in a location that is attractive to the desired species. Care should be taken that this does not disrupt a late seral stage site in use by wading birds.

d. Maintain bare sand habitat. Bare sand/shell/gravel is in short supply in New Jersey and the two state endangered colonial species, least terns and black skimmers, both require this type of substrate for nesting. Present or previously used nest sites should be maintained at a very early seral stage for these species. Defoliation and disking or controlled burning procedures should be investigated on sites currently in use that are becoming too densely vegetated.

e. Alternative colony sites. Because of predation or human disturbance, it is important that colonial nesting species have alternate nest sites available to them (e.g. Pork Island heronry was burned out in May 1977) if they should have to desert a colony site early in the season. At the Stingaree Point colony red fox predation in early May 1977 disrupted a large mixed-species heronry, causing a number of birds to desert their nests. Nearby colonies at Shaw Cutoff and Shaw Island were available and did increase in numbers as the Stingaree Point colony decreased. Maintenance of alternative sites with suitable habitat in the same general location will allow not only the reduction of disturbance pressures but also facilitate a program of rotational management at each site.

f. Rotational management. The placement of several dredged material islands in the same general location will allow a planned pattern of disposal and seral stage development, with disposal at the same site at planned intervals coinciding with the need for bare sand or early, mid and late seral stage management. Late seral stage development and management would have to have at least 10 to 20 year intervals between depositions on alternating islands to provide required vegetation for wading birds. Shorter term management programs could be used for terns and skimmers. Forster's terns and laughing gulls would be unaffected unless disposal occurred on salt marsh nesting sites. Management programs to provide needed sand habitat to common terns, unsuitable for gulls, would be desirable since gull species prey on eggs and young of other colonial species.

g. Wading bird management considerations. Wading birds use dredged material islands more than other colonial species in New Jersey. Their preference for shrub, shrub-forest and reed-shrub communities means that long-term management programs are needed. Currently, there seem to be adequate suitable islands available to them for colony sites. Dredged material disposal would disrupt or destroy the more advanced upland vegetation that herons require. Only a few of their present colony sites (40, A80a) are diked. These sites are on comparatively large-sized islands with low, overgrown dikes, and the actual colonies

are well away from the dikes. It is recommended that islands supporting heronries be left undisturbed because of the 10 to 20 year time period required to attain the proper plant communities required by these birds. But, if use of these sites is unavoidable, and diking must be used, it is recommended that compartmentalized diking with disposal in only a portion of the island removed from the heronry be done in order to preserve the heronry site. Any activities on the island should be during the non-nesting season. Yearly wading bird movements between nesting colony sites should be noted. The presence of herons at certain previously used sites in May 1977 and their movement by June, combined with other historical data (Appendix A), indicate that waiting periods of 2 to 3 years is needed before disposal at a colony site resumes.

h. Proportional representation. Working in cooperation with State and Federal ornithologists, various seral stages on dredged material sites should be maintained along the New Jersey Intracoastal Waterway in various proportions. The present distribution of colonial species at dredged material sites indicates that different deposit configurations attract different species. Low elevation broadcasting of dredged material could be used to provide salt marsh nest sites for laughing gulls, gull-billed terns, and possibly Forster's terns. High, domed, circular islands are all but lacking in New Jersey (A12 is the only such site) but would attract least terns, common terns, and black skimmers for many years because of the longer time period required for them to become densely vegetated and unsuitable to terns and skimmers. Lower domed, large islands which become vegetated more rapidly could be placed in desirable locations and allowed to develop late seral stage vegetation naturally or by planting maritime shrubs for wading birds or managed to maintain early and mid seral stages of vegetation utilized by common terns, black skimmers, and least terns.

i. Diking. The desirability of diking has not been investigated in New Jersey. The fact that such islands do not support a major proportion of the colonial bird population in New Jersey despite their bare sand availability would indicate that they are in some way undesirable. However, the presence of least terns on these sites and heronries on several older diked sites necessitates further investigation of these sites before supportable conclusions can be drawn.

j. Protection on dredged material islands. The paucity of undeveloped, undisturbed, and uncrowded bare sand in New Jersey, coupled with recreational users such as boaters, swimmers, and picnickers attracted to dredged material island beaches is a definite problem. They walk through seabird colonies, bring their dogs, and generally disrupt nesting birds. The

State of New Jersey has instituted a posting program for least tern colonies which may be helpful in minimizing human disturbance at these sites. This program should be expanded to include all colonial bird colonies and all dredged material island colonies especially. Buckley and Buckley (1976) provide numerous means of dealing with protection problems.

165. The preceding list of management recommendations is not meant to provide a complete management program for dredged material islands or colonial nesting seabirds and wading birds. It is hoped that these recommendations can be a starting point for further investigation by the Corps of Engineers in cooperation with the many groups and agencies that are concerned with the management, preservation and protection of our wildlife resources. Dredged material islands can provide much needed habitat for many species, as this study has shown, and their enlightened management and use of wildlife purposes should be encouraged.

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APPENDIX A: A HISTORICAL PERSPECTIVE

(on microfiche in pocket of inside back cover)

APPENDIX B: VEGETATION ANALYSIS

(on microfiche in pocket of inside back cover)

APPENDIX C: MISCELLANEOUS MAPS AND FIGURES

Table C1

New Jersey Intracoastal Waterway Dredged Material Sites

Number	Name	Latitude	Longitude	Hectares	Age	Reference
A12 North*	Pelican Island North	$39^{o}57'$	$74^{o}05'$	6.4 **	pre 1969[3]	2
A12*	Pelican Island	$39^{o}57'$	$74^{o}05'$	2.6 **	pre 1969[3]	2
A35*	East Carvel Island	$39^{o}41'$	$74^{o}10'$	2.5 **	pre 1969[3]	3
X18	Cedar Bonnet	$39^{o}39'$	$74^{o}12'$	2.04	1977	3
40	Flat Island	$39^{o}38'$	$74^{o}12'$	23.4	1965	1
A40	High Island	$39^{o}37'$	$74^{o}12'$	6.4	n.a.	2
A43a*	Ham Island	$39^{o}36'$	$74^{o}13'$	8.1	n.a.	2
A43b	Marshelder Island East	$39^{o}35'$	$74^{o}14'$	27.9	n.a.	1
	Marshelder Island West	$39^{o}35'$	$74^{o}14'$	27.9	n.a.	1
45A*	Parker Island	$39^{o}34'$	$74^{o}15'$	5.6	1976	1
45B*	-----	$39^{o}34'$	$74^{o}15'$	1.6	1976	1
X47	Barrel Island	$39^{o}34'$	$74^{o}17'$	20.7	1963	1
X27*	Goosebar Sedge	$39^{o}32'$	$74^{o}17'$	13.2	pre 1969	3

(Continued)

* study island

** estimated size

1 U.S. Army Corps of Engineers, Philadelphia District

2 Nordstrom et al. 1974

3. Ocean County Mosquito Commission

4. total island size, (Cape May County Records); study site - 1.2 ha

5 New Jersey Department of Environmental Protection

6 bird banding data, U.S. Fish and Wildlife Service

n.a. = not available

Table C1 (Continued)

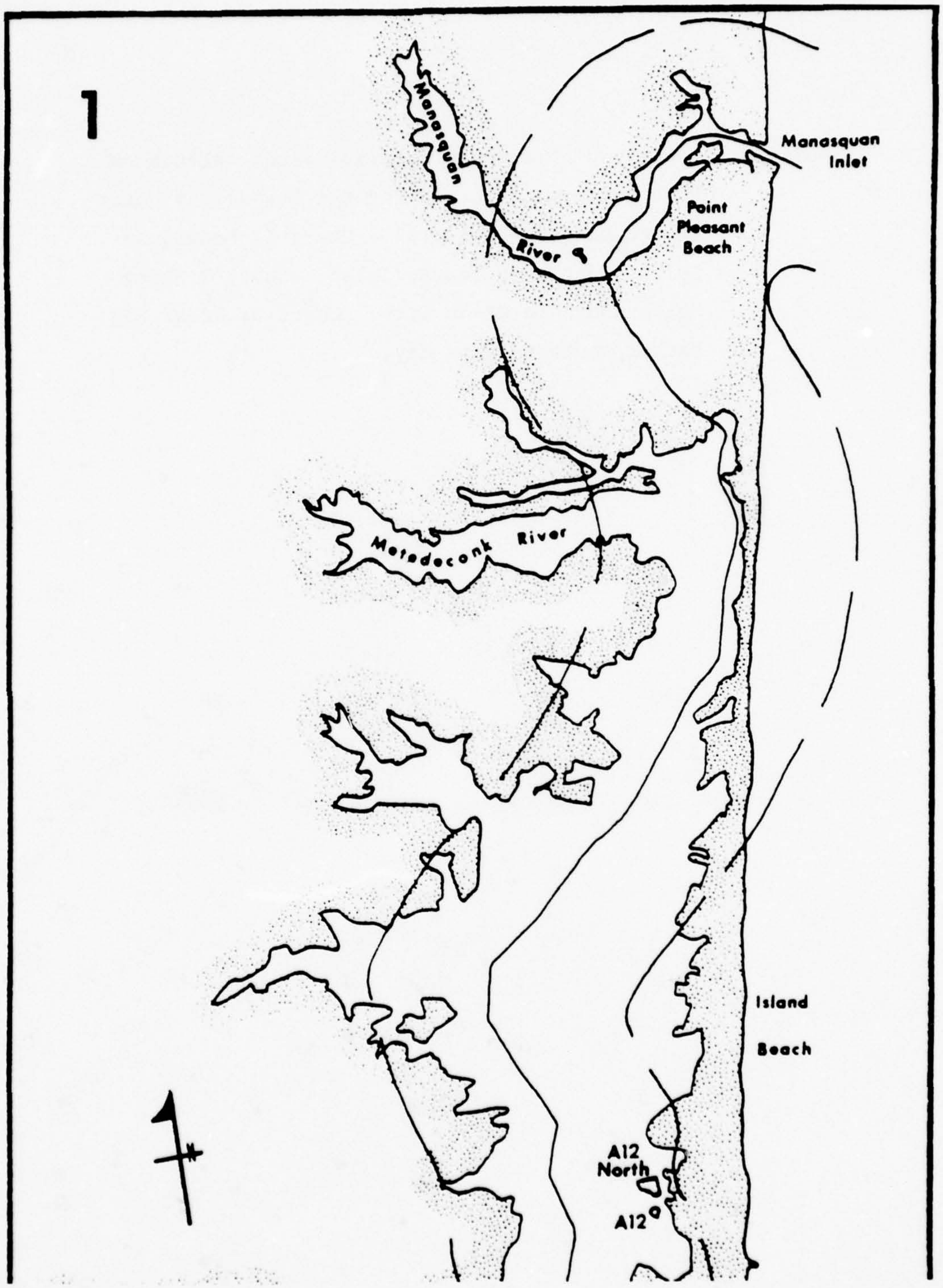
Number	Name	Latitude	Longitude	Hectares	Age	Reference
51B*	Shooting Thorofare	39°31'	74°18'	17.0	1965	1
58	Shad Island	39°28'	74°24'	11.3	1977	1
A59a*	Perch Cove Pt./Big Shad	39°28'	74°24'	2.4	1968	1
60	Black Point	39°26'	74°24'	11.3	1976	1
61	Oyster Thoro Marsh	39°26'	74°24'	71.5	1967	1
A61b	Islajo	39°25'	74°25'	8.8	pre 1959	6
A61c*	Little Heron Island	39°24'	74°26'	5.5	pre 1959	6
65	---	39°33'	74°25'	6.8	1969	1
77	Risley Channel	39°20'	74°33'	109.1	1964	1
78A	Broad Thorofare	39°19'	74°34'	109.9	1976	1
78B*	Broad Thorofare	39°19'	74°34'	50.9	1969	1
A80a	Cowpens Island	39°17'	74°35'	49.3	n.a.	5
A80b	Shooting Island	39°16'	74°36'	29.9	n.a.	2
82	Beach Thoro	39°16'	74°38'	5.7	1969	1
82A	----	39°16'	74°36'	8.1	1974	1
83	Crook Horn Creek	39°16'	74°38'	12.5	1964	1
84	Crook Horn Creek	39°14'	74°38'	11.0	1976	1
84A	Crook Horn Creek	39°14'	74°38'	3.4	1976	1
85A	Beach Creek	39°14'	74°39'	17.0	1976	1
85dmi*	Weakfish Creek	39°13'	74°39'	3.1	1966	1
85B	Middle Thoro	39°13'	74°39'	13.6	1966	1
85 South*	Middle Thoro	39°15'	74°39'	13.6	1966	1

(Continued)

Table C1 (Concluded)

Number	Name	Latitude	Longitude	Hectares	Age	Reference
85C*	Devils Thoro	$39^{\circ}14'$	$74^{\circ}39'$	13.6	1976	1
86	Ben Hands Thoro	$39^{\circ}12'$	$74^{\circ}40'$	34.1	1968	1
90	Ludlum Bay	$39^{\circ}10'$	$74^{\circ}42'$	20.4	1977	1
97A	----	$39^{\circ}06'$	$74^{\circ}46'$	27.3	1968	1
97B	Great Sound	$39^{\circ}06'$	$74^{\circ}46'$	20.4	1968	1
98A*	Sturgeon Island	$39^{\circ}05'$	$74^{\circ}46'$	5.9	1968	1
98B North*	Gull Island North	$39^{\circ}05'$	$74^{\circ}46'$	14.5	1968	1
98B South*	Gull Island South	$39^{\circ}05'$	$74^{\circ}46'$	14.5	1968	1
103*	Nummy Island	$39^{\circ}02'$	$74^{\circ}48'$	129.3	1975	1
106	North Wildwood Road	$39^{\circ}02'$	$74^{\circ}49'$	0.8	1963	1
108A	Grassy Sound Channel	$39^{\circ}00'$	$74^{\circ}50'$	7.7	1974	1
108B*	----	$39^{\circ}00'$	$74^{\circ}50'$	2.8	1965	1
108C	----	$38^{\circ}59'$	$74^{\circ}50'$	6.8	n.a.	1
109*	Shaw Island	$38^{\circ}59'$	$74^{\circ}51'$	32.7	1965	1
109 South*	------	$38^{\circ}59'$	$74^{\circ}51'$	2.0	1965?	2

Figure C1. Locations of dredged material study islands on NOAA navigation charts for the New Jersey coast (three different charts). Chart 1: Manasquan Inlet south to Barnegat Inlet. Chart 2: Long Beach south to Ocean City. Chart 3: Great Egg Harbor south to Cape May.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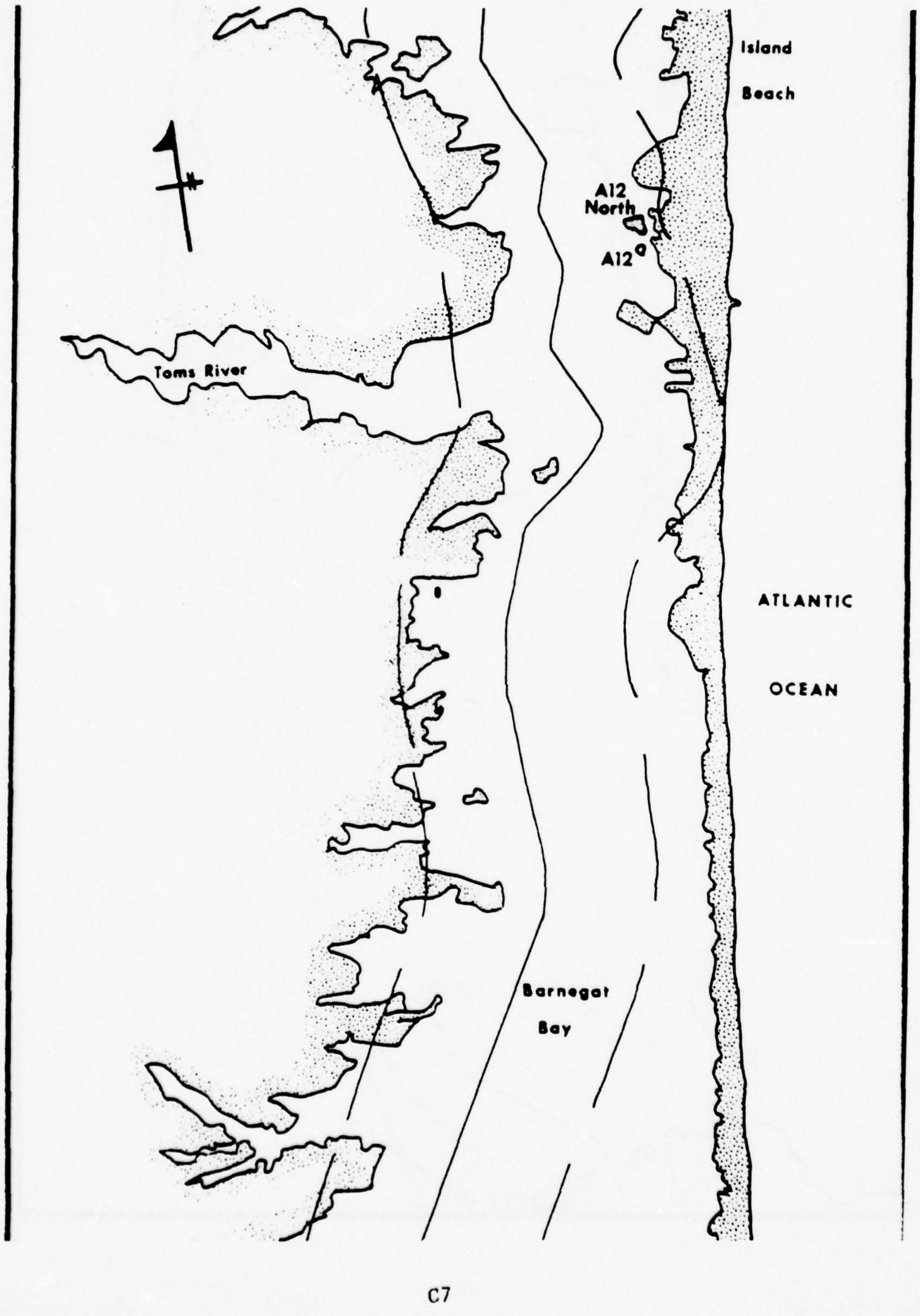
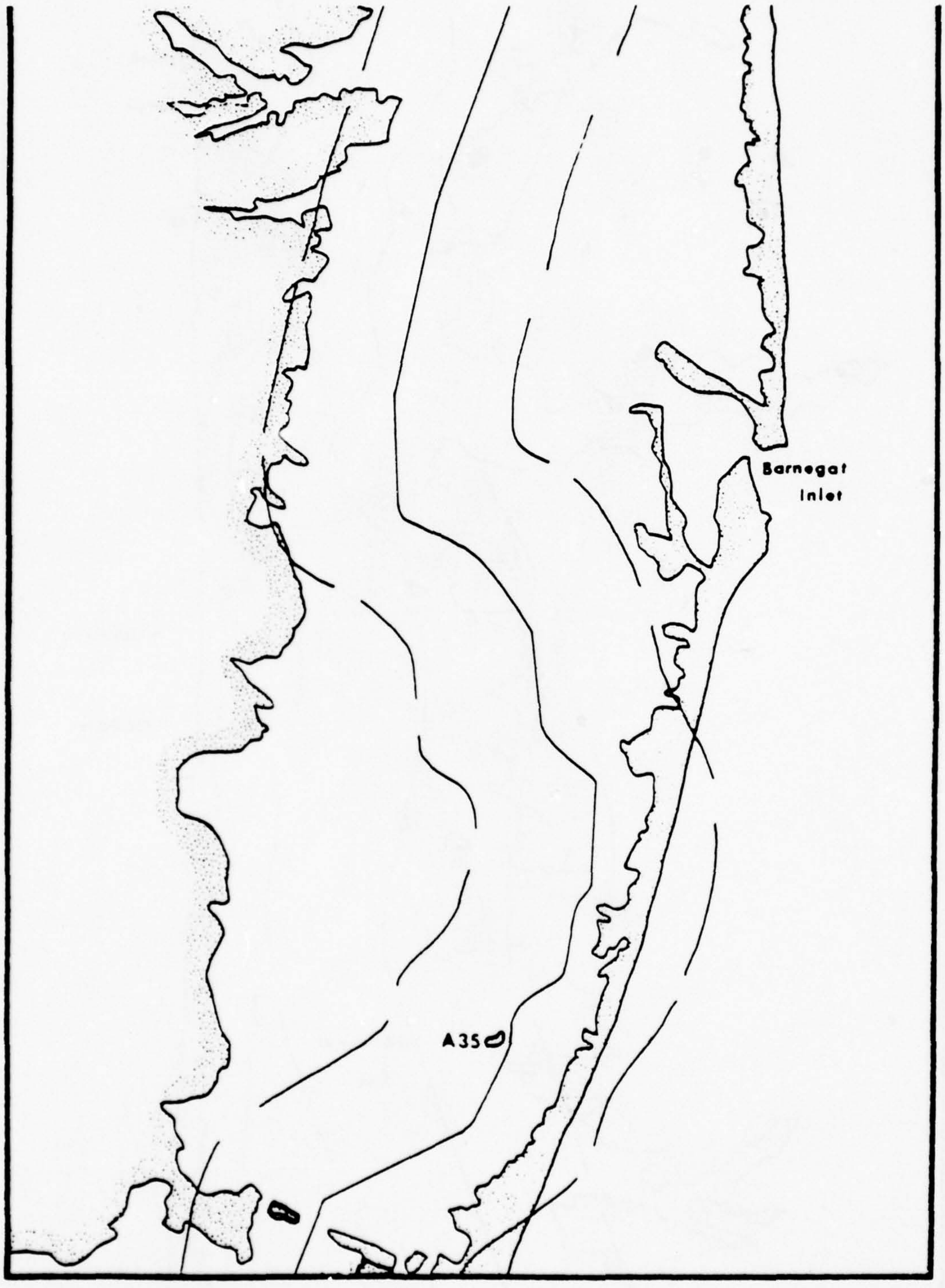
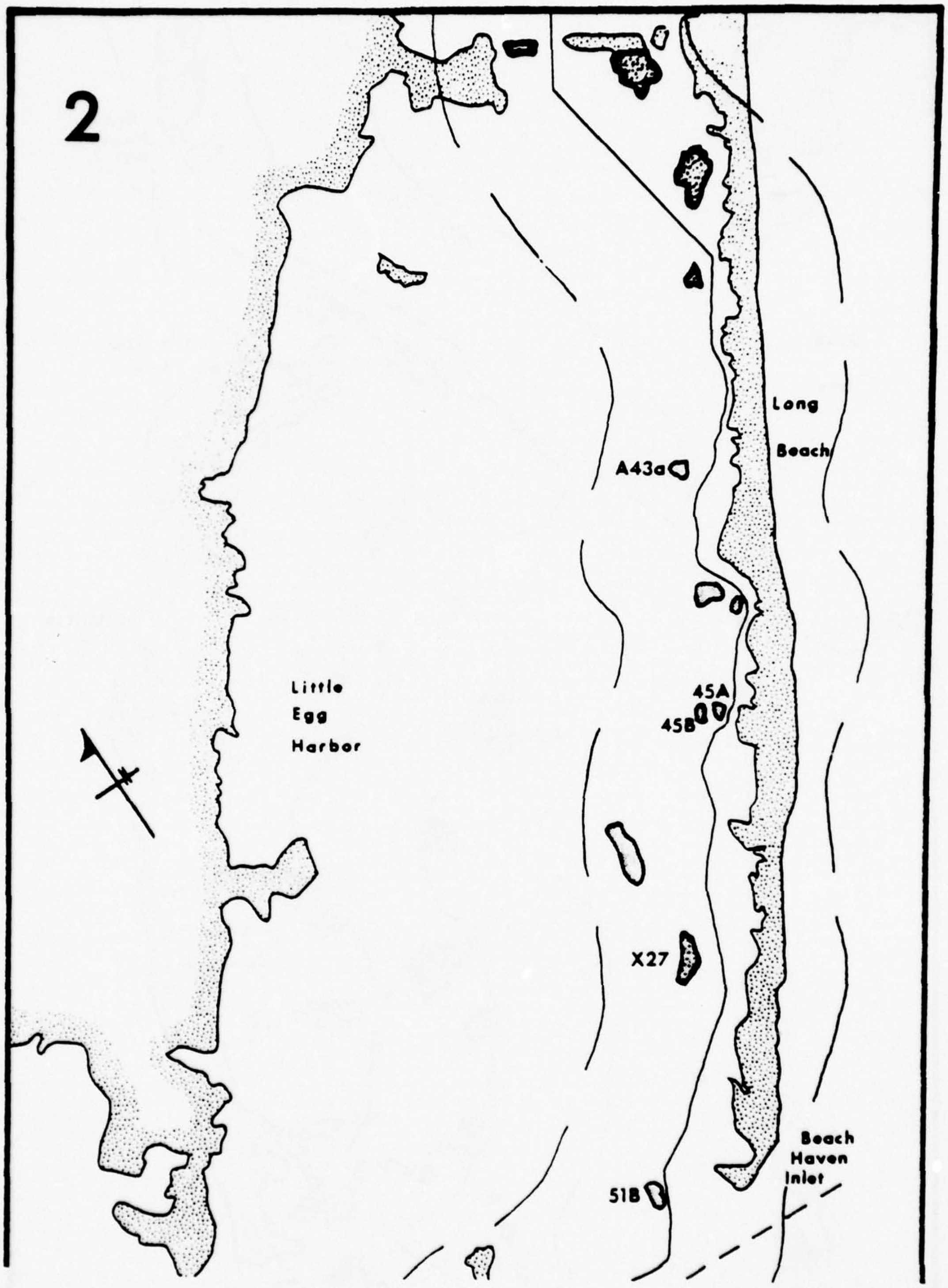
Manasquan
Inlet
Point
Pleasant
Beach
Metedeconk River
Island
Beach
A12
North
A12


Island
Beach
A12
North
A12
Toms River
ATLANTIC
OCEAN
Barnegat
Bay


Barnegat
Inlet
A35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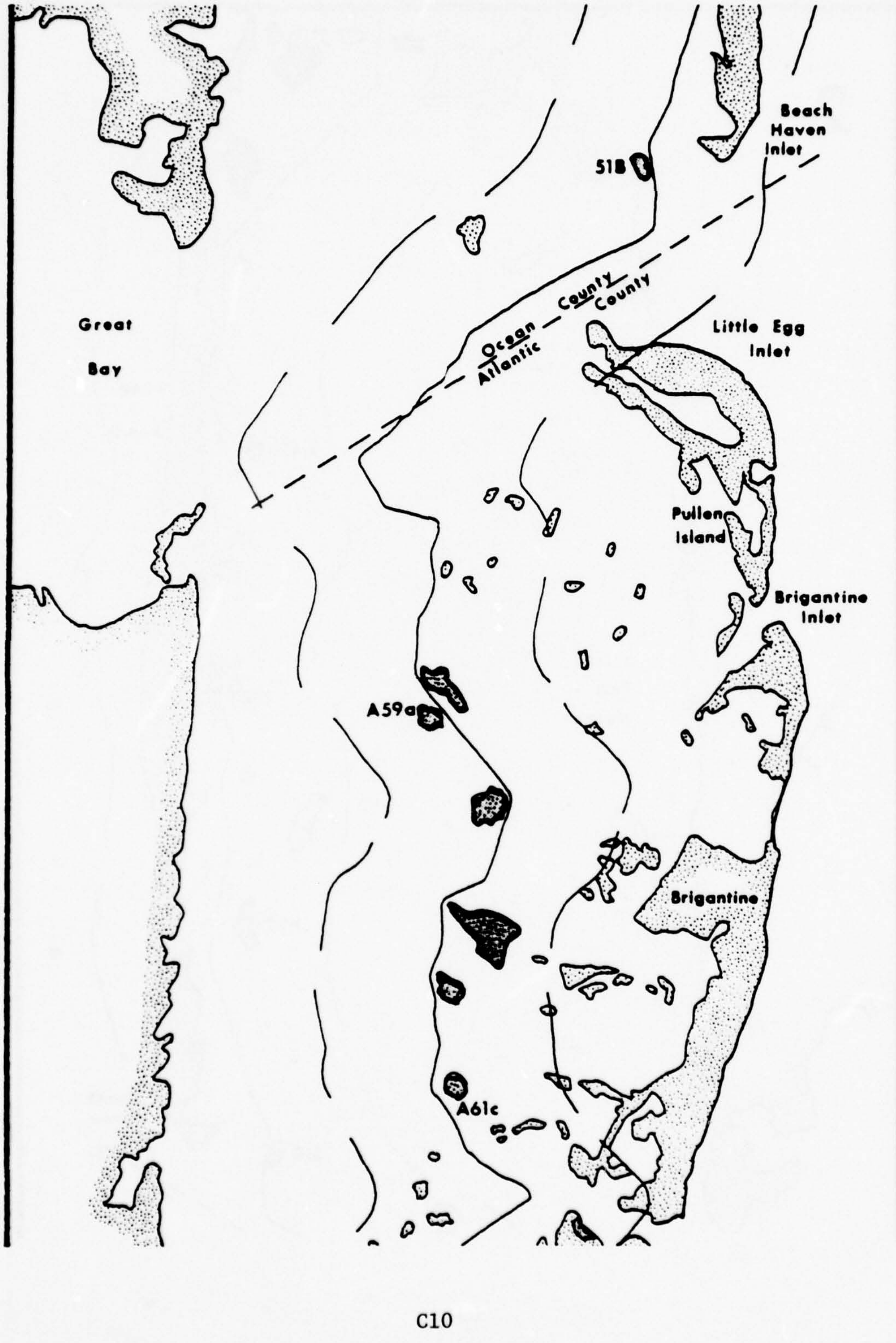
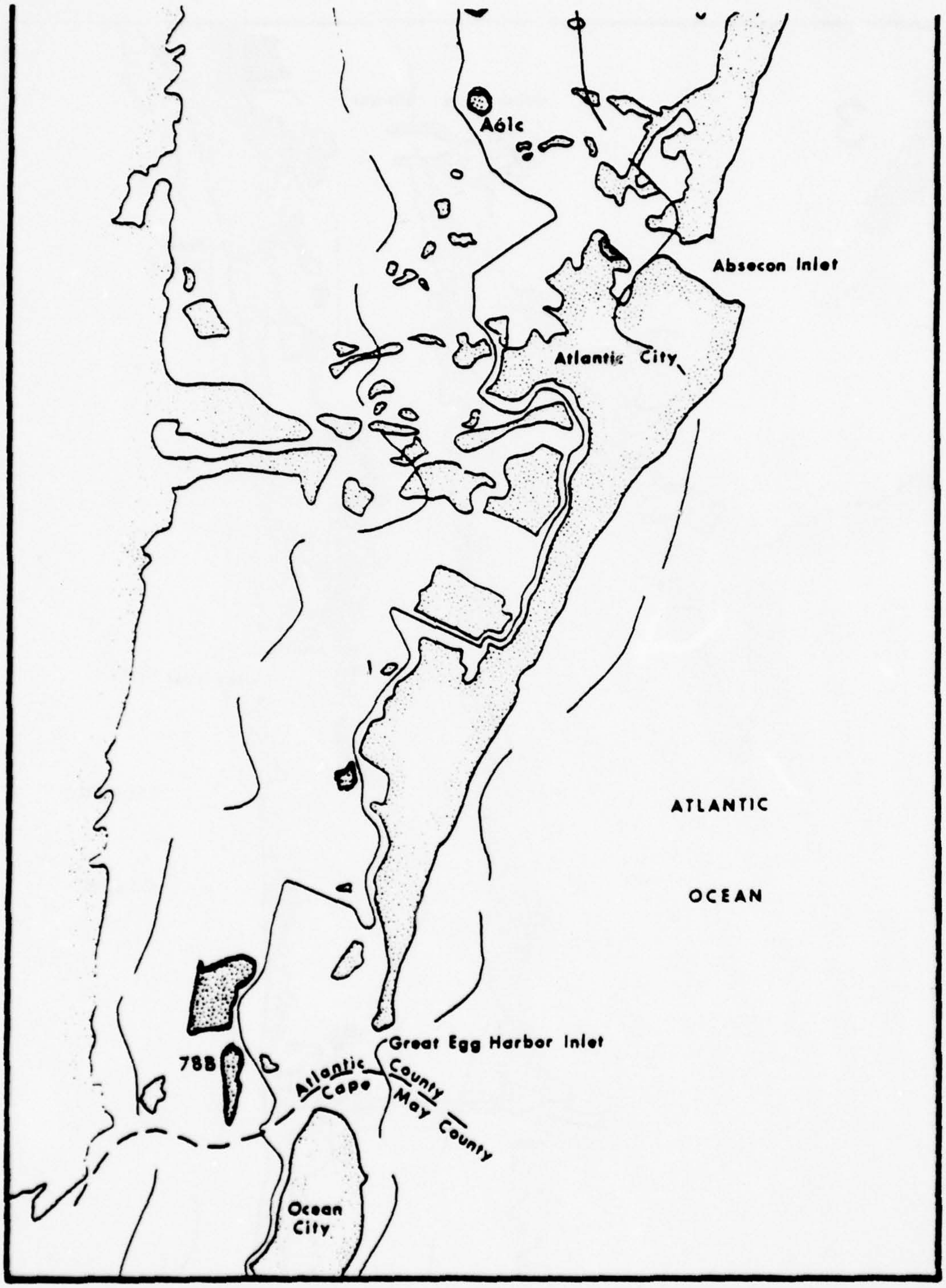
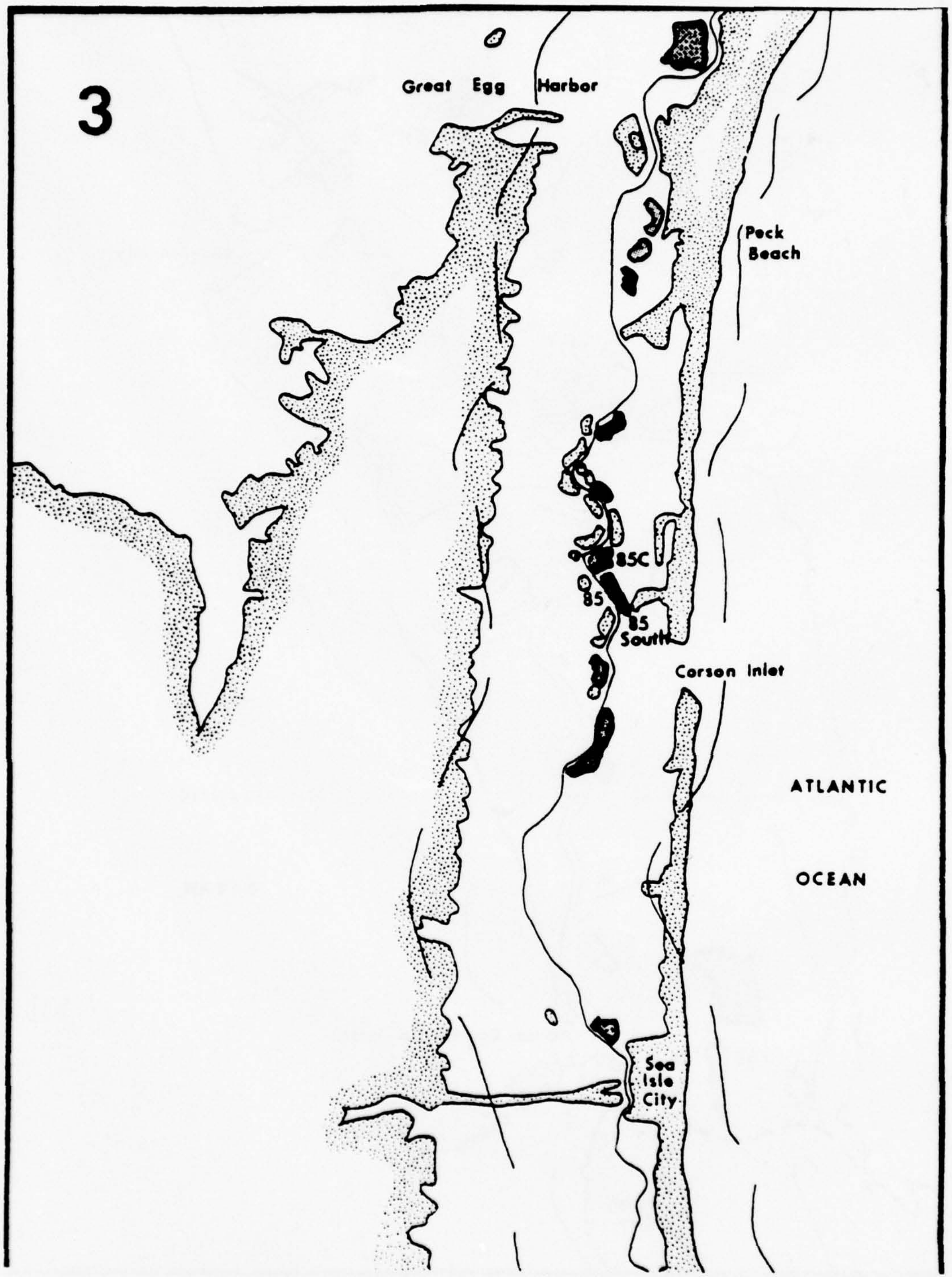
Long
Beach
A43a
Little
Egg
Harbor
45A
45B
X27
Beach
Haven
Inlet
51B

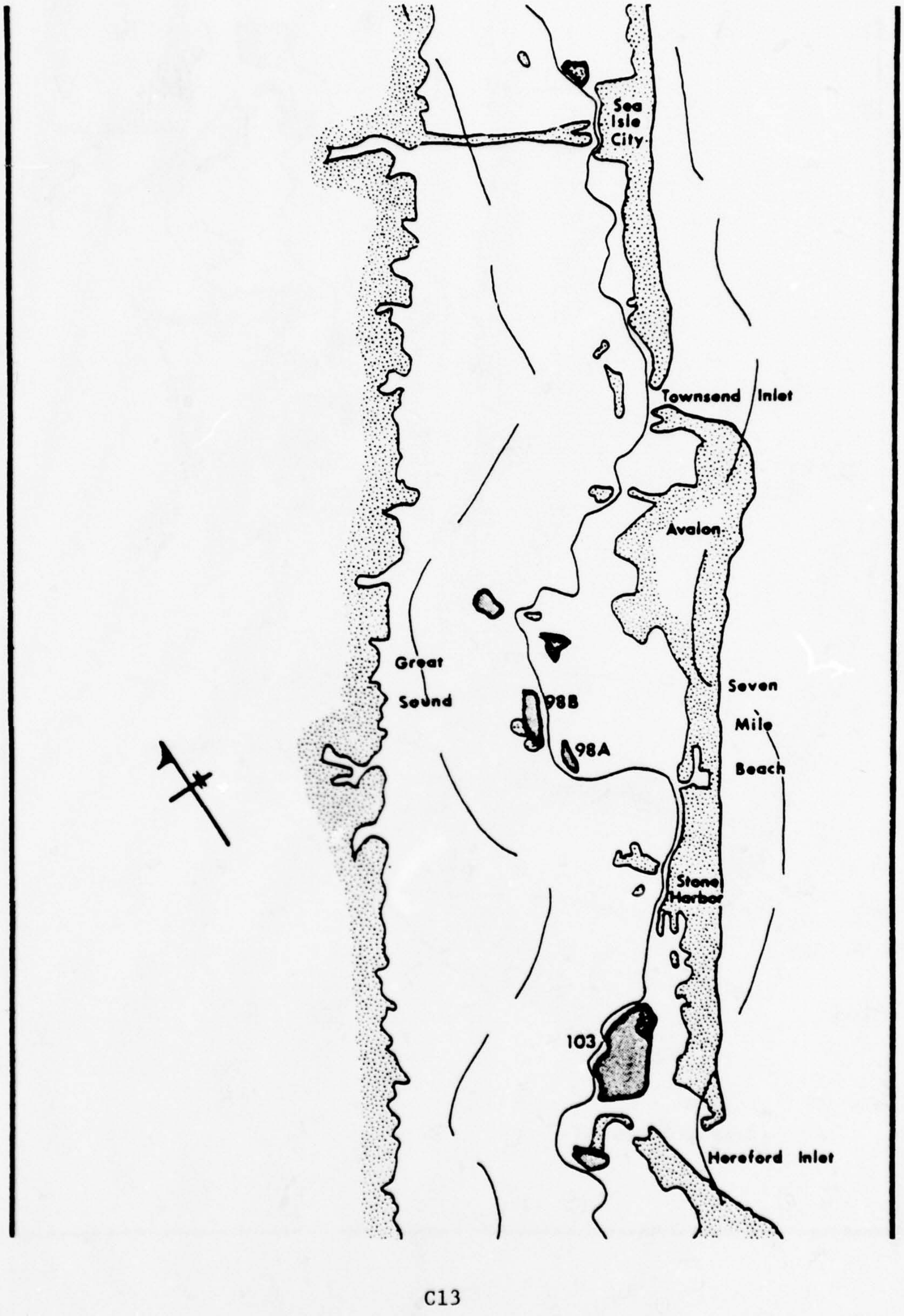


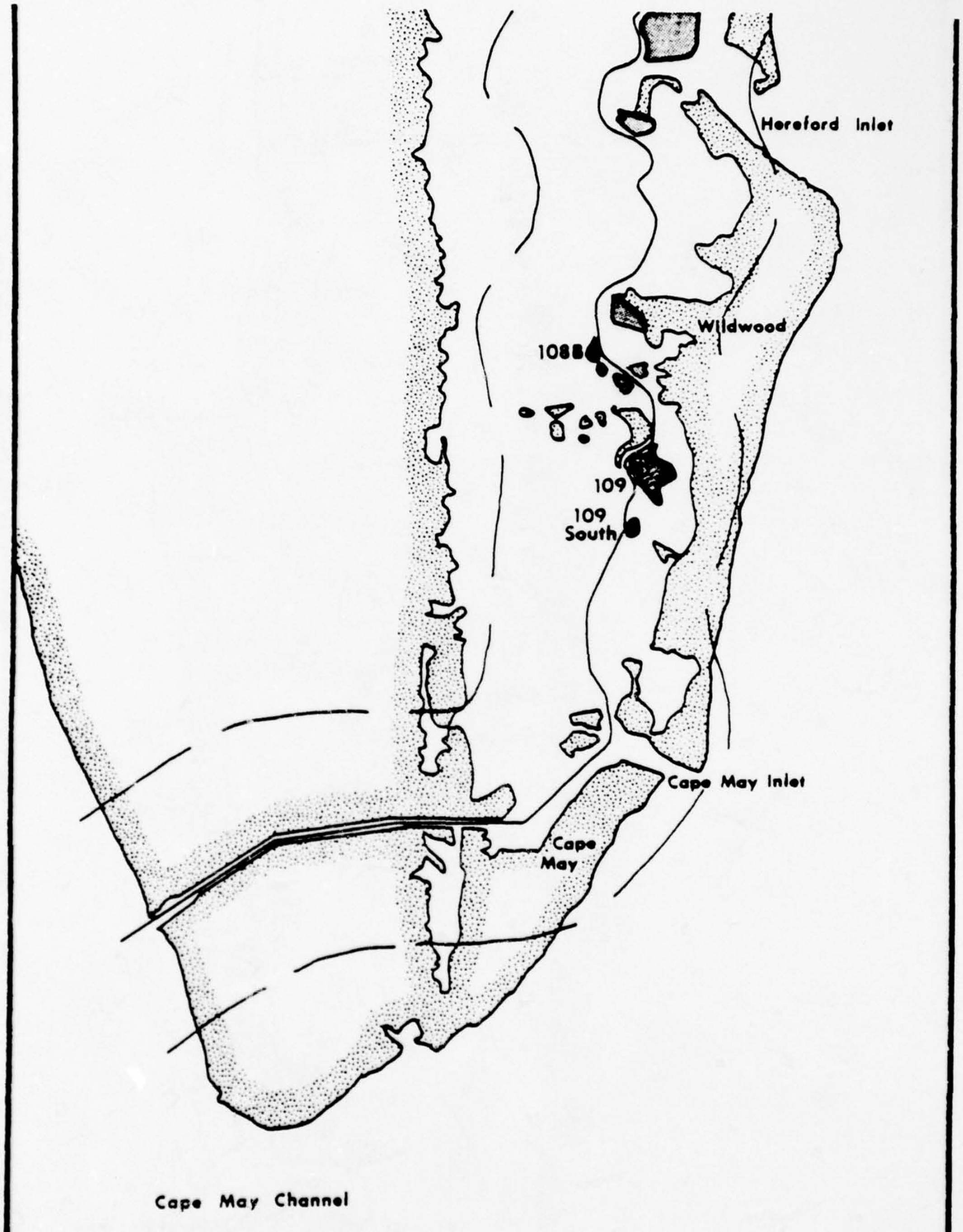
Beach
Haven
Inlet
51B
Great
Bay
Ocean
Atlantic
County
County
Little Egg
Inlet
Pullen
Island
Brigantine
Inlet
A59a
Brigantine
A61c



A61c
Absecon Inlet
Atlantic City
ATLANTIC
OCEAN
Great Egg Harbor Inlet
78B
Atlantic
Cape
County
May
County
Ocean
City


3
Great Egg Harbor
Peck Beach
85C
85
85 South
Corson Inlet
ATLANTIC
OCEAN
Sea Isle City


Sea
Isle
City
Townsend Inlet
Avalon
Great
Sound
Seven
Mile
Beach
98B
98A
Stone
Harbor
103
Hereford Inlet

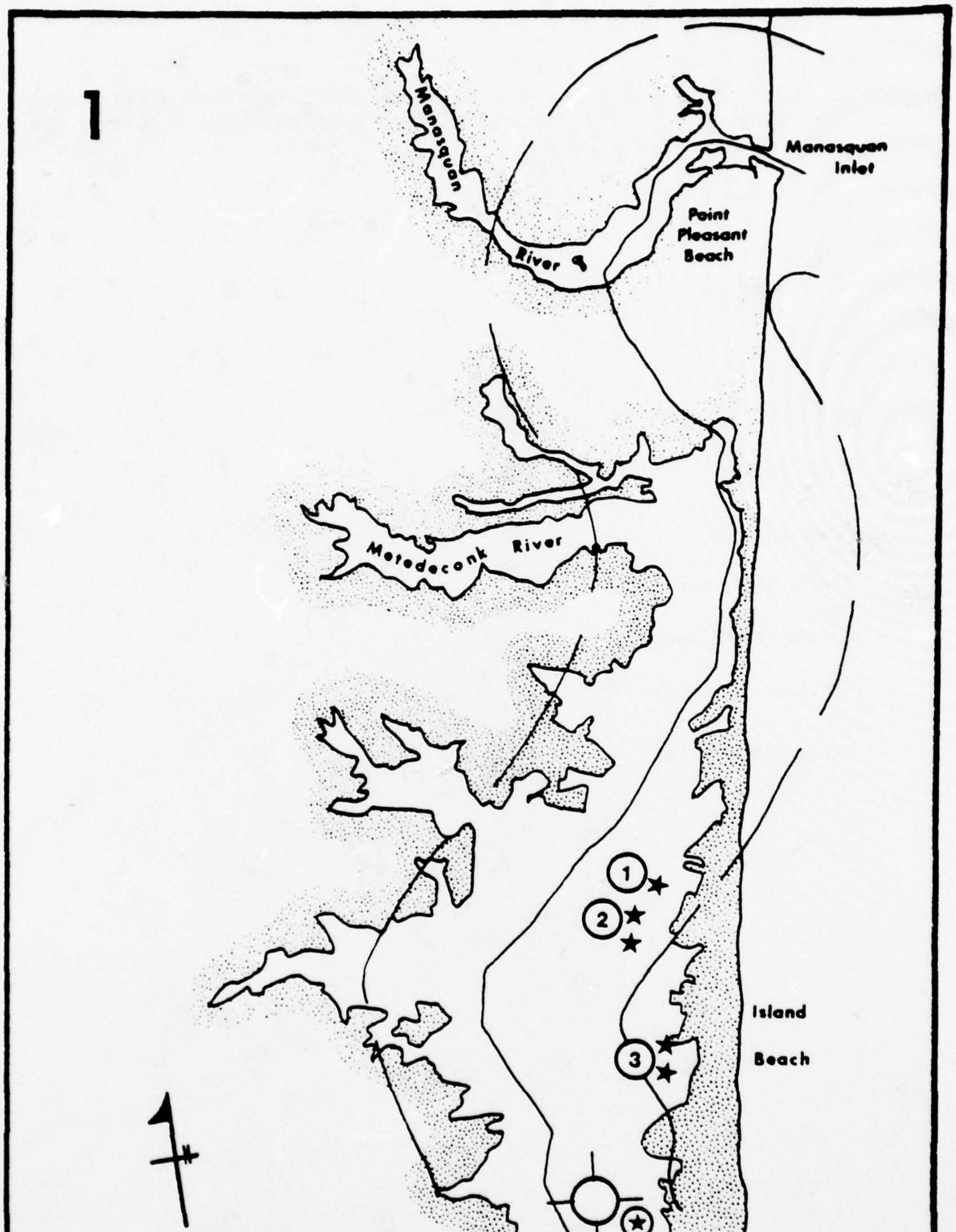


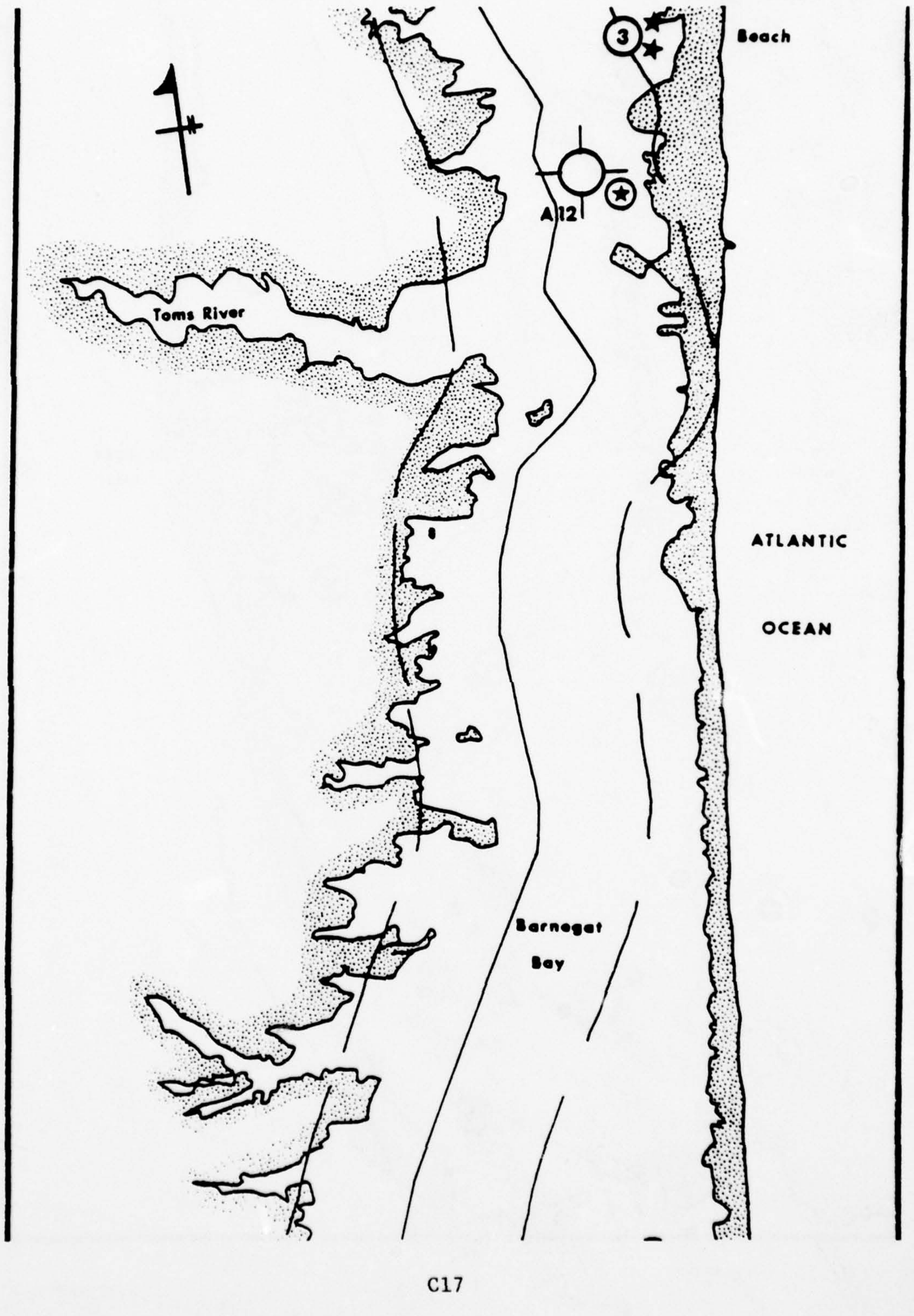
Hereford Inlet
Wildwood
108B
109
109
South
Cape May Inlet
Cape
May
Cape May Channel

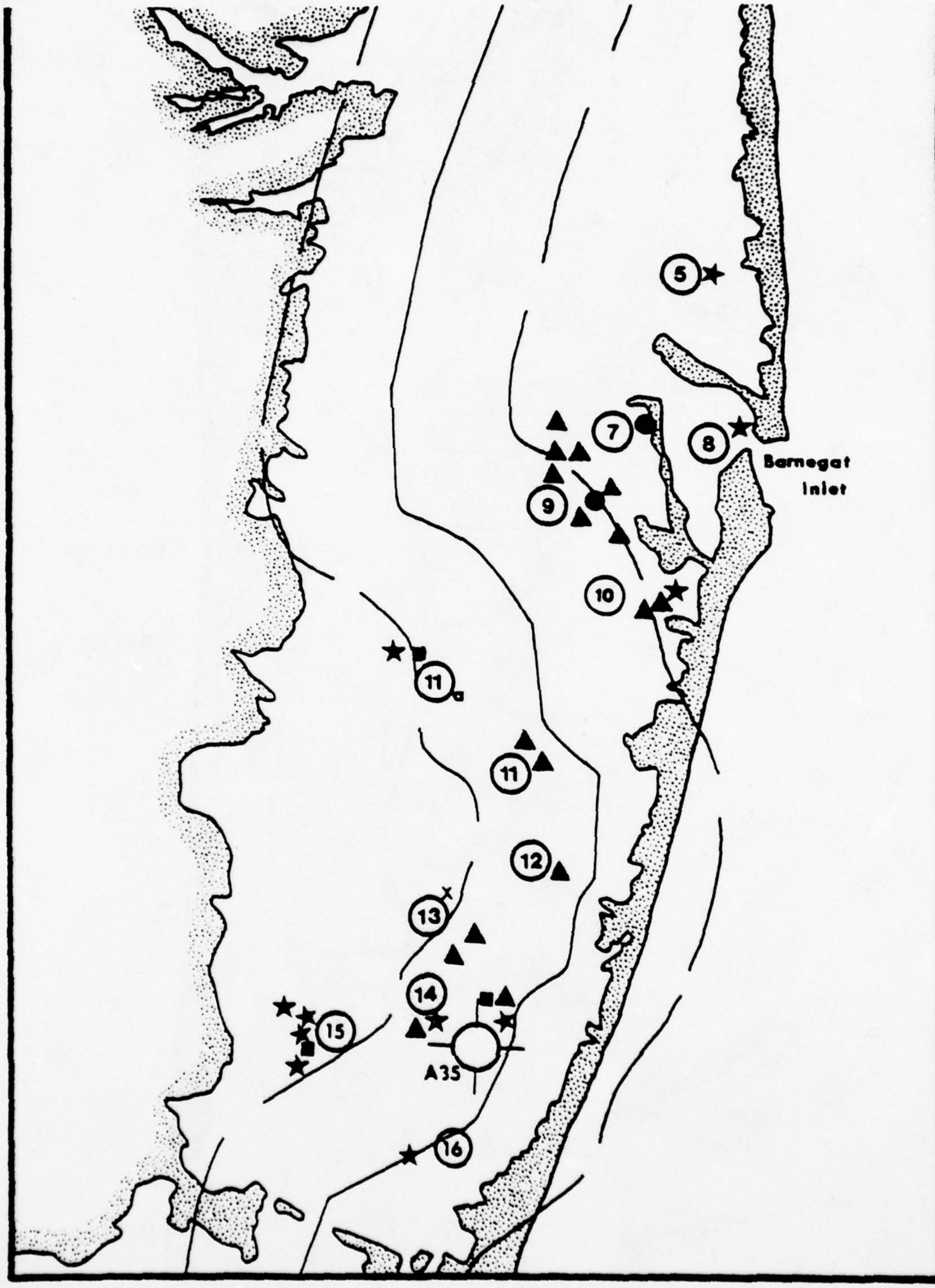
Figure C2. Waterbird colonies located along the New Jersey Intercoastal Waterway in 1977, shown on three NOAA navigation charts for the New Jersey coast.

Key:

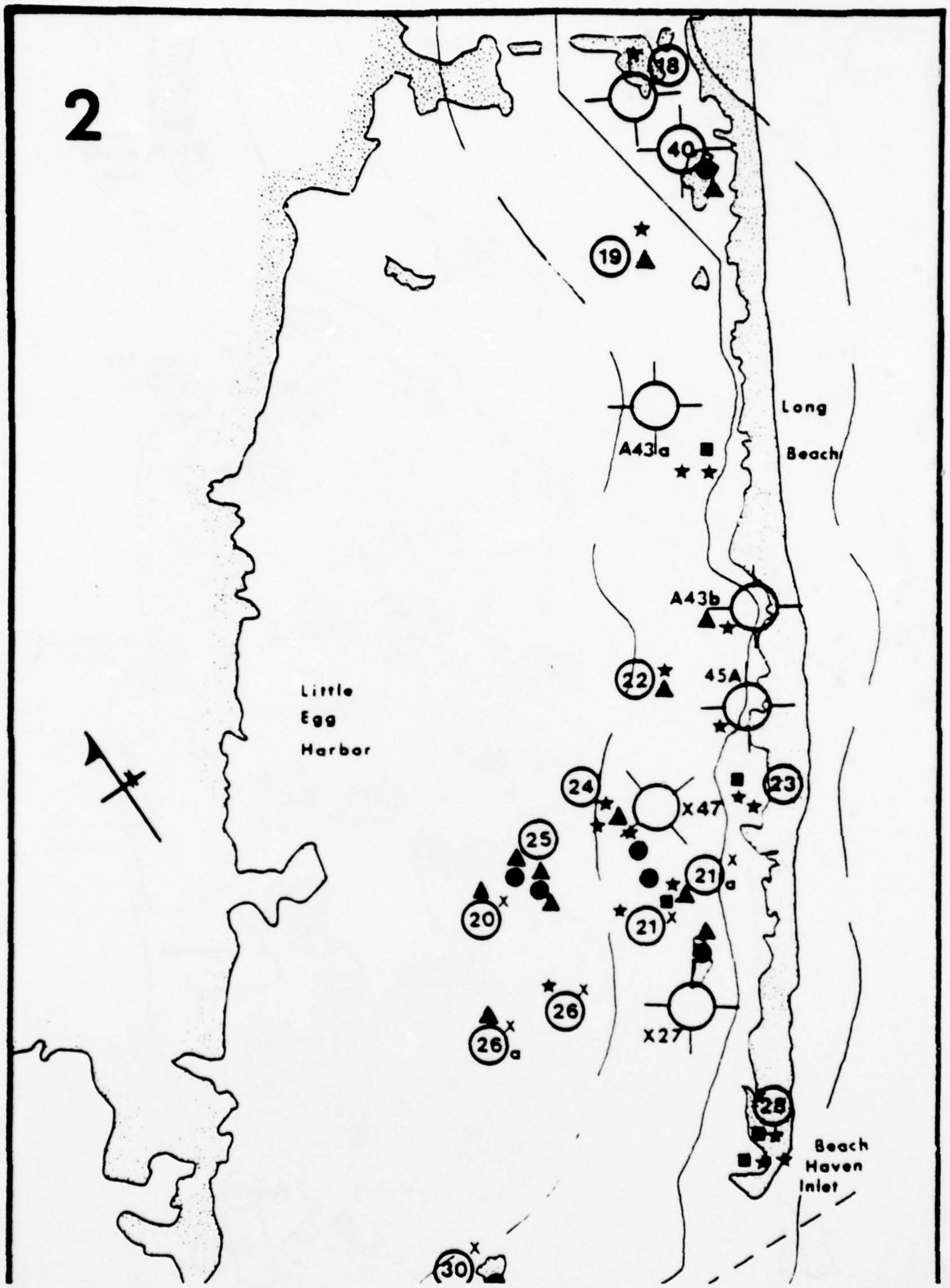
Heronry	●
Gull colony	▲
Tern colony	★
Black skimmers	■
Colony site locations	#
New colony sites	#*
Dredged material study sites	¤

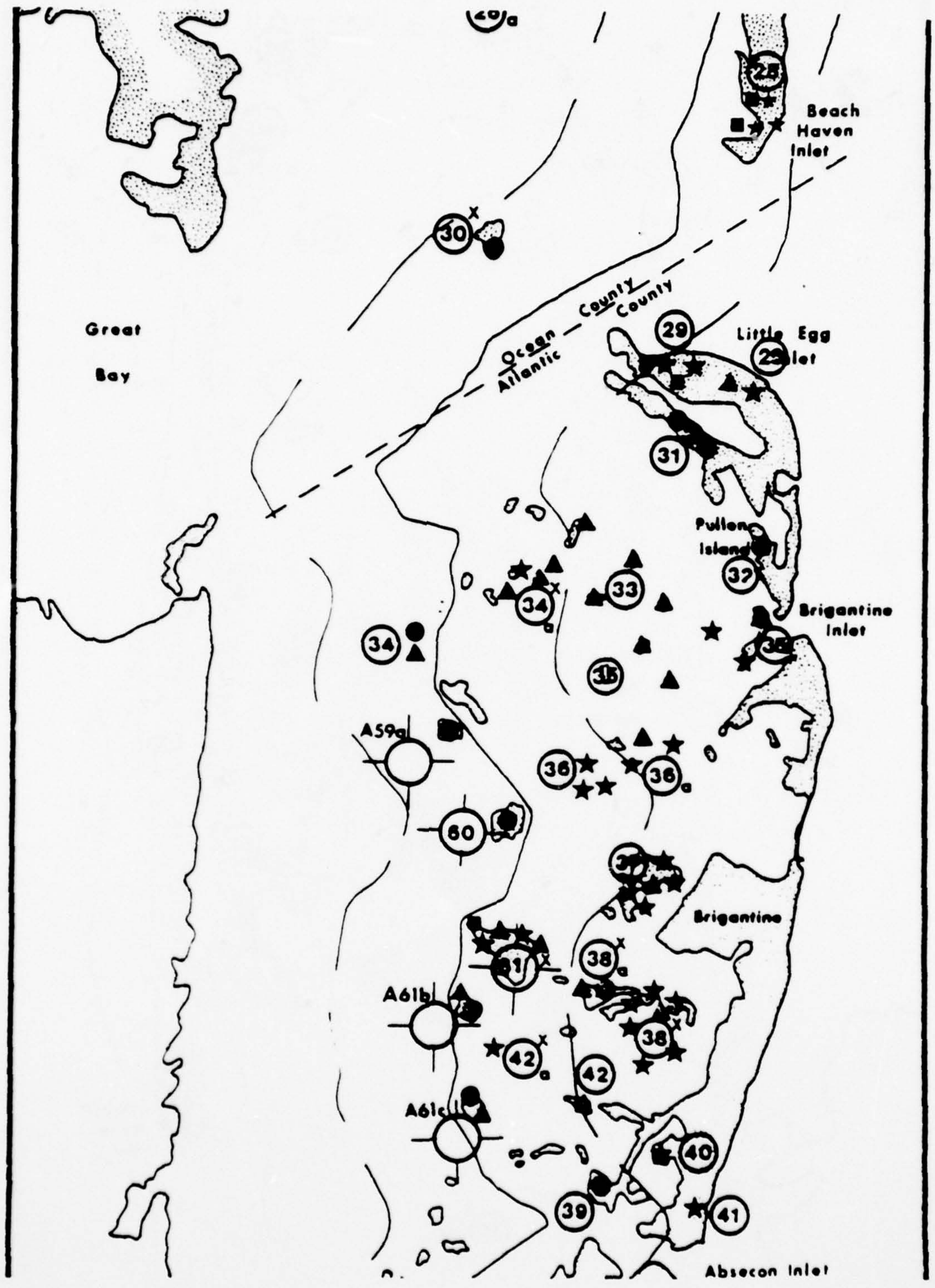

1
Manasquan
River
Manasquan
Inlet
Point
Pleasant
Beach
Metedeconk River
1
2
3
Island
Beach
A 12


Beach
3
A12
Toms River
ATLANTIC
OCEAN
Barnegat
Bay



5
7
8
Barnegat
Inlet
9
10
11a
11
12
13
14
15
A35
16


2
18
40
19
Long
Beach
A43a
A43b
22
45A
Little
Egg
Harbor
24
X47
23
25
21
a
20
21
26
26
a
X27
28
Beach
Haven
Inlet
30


Beach Haven Inlet
Great Bay
Ocean County
Atlantic County
Little Egg Inlet
Pullen Island
Brigantine Inlet
Brigantine
Absecon Inlet
A59a
60
A61b
A61c
30
29
31
32
33
34
35
36
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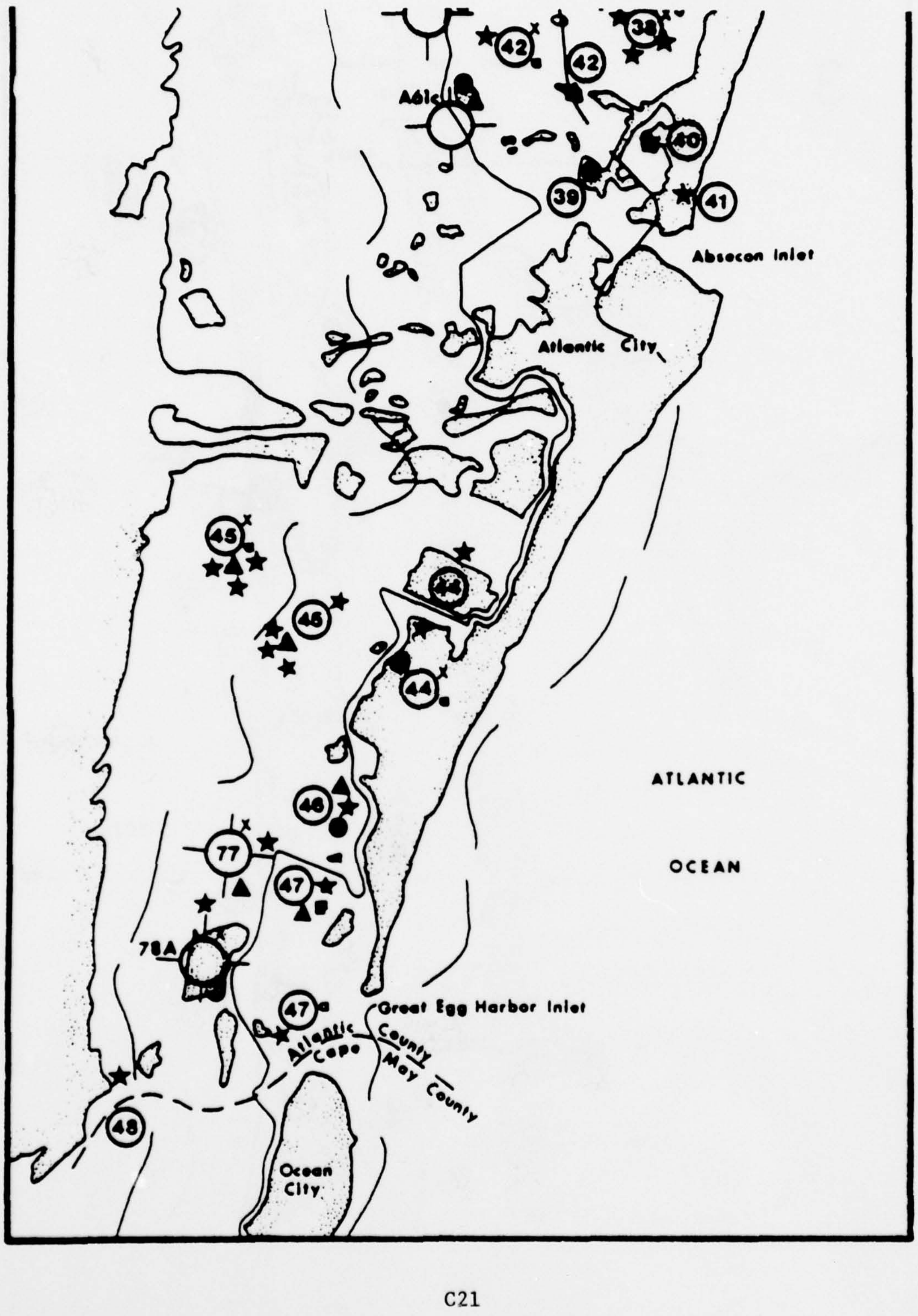
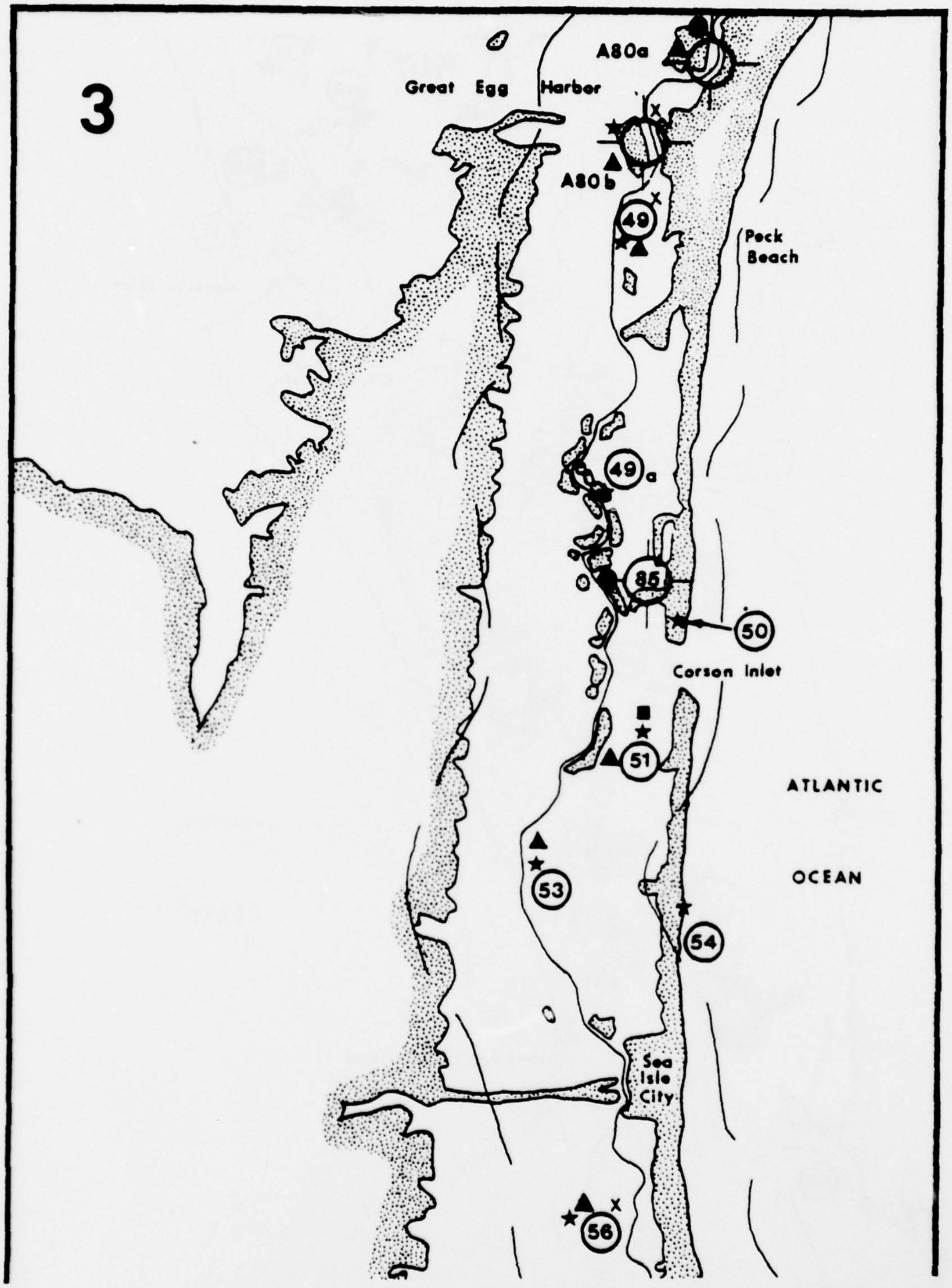
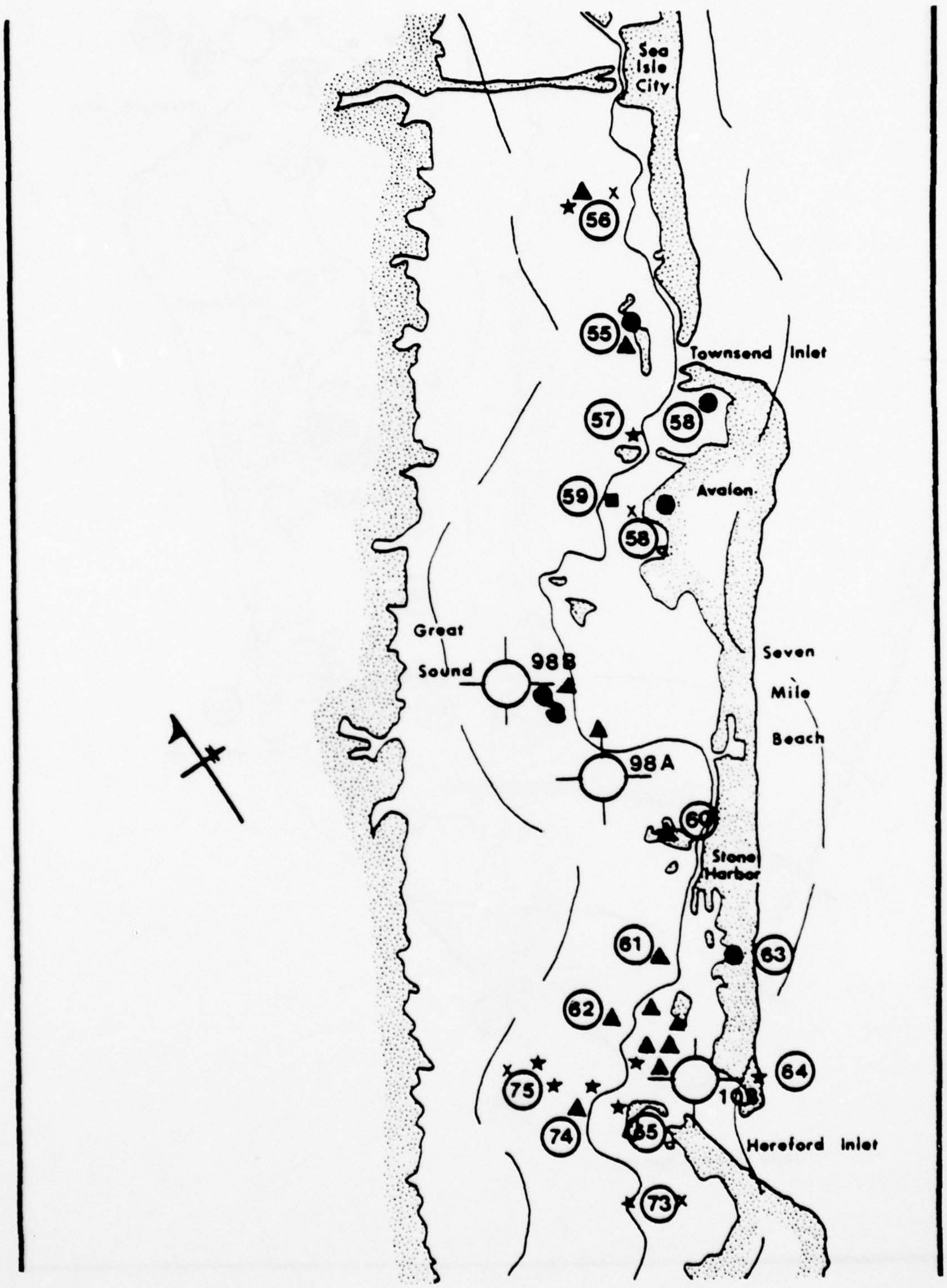
38
39
40
41
42



42
42
38
A6
40
39
41
Absecon Inlet
Atlantic City
45
46
44
ATLANTIC
OCEAN
46
77
47
78A
47
Great Egg Harbor Inlet
Atlantic County
Cape May County
48
Ocean City


3
Great Egg Harbor
A80a
A80b
49
Peck Beach
49a
85
50
Corson Inlet
51
ATLANTIC
OCEAN
53
54
Sea Isle City
56


Sea Isle City
56
55
Townsend Inlet
57
58
59
Avalon
58
Great Sound
98B
Seven Mile Beach
98A
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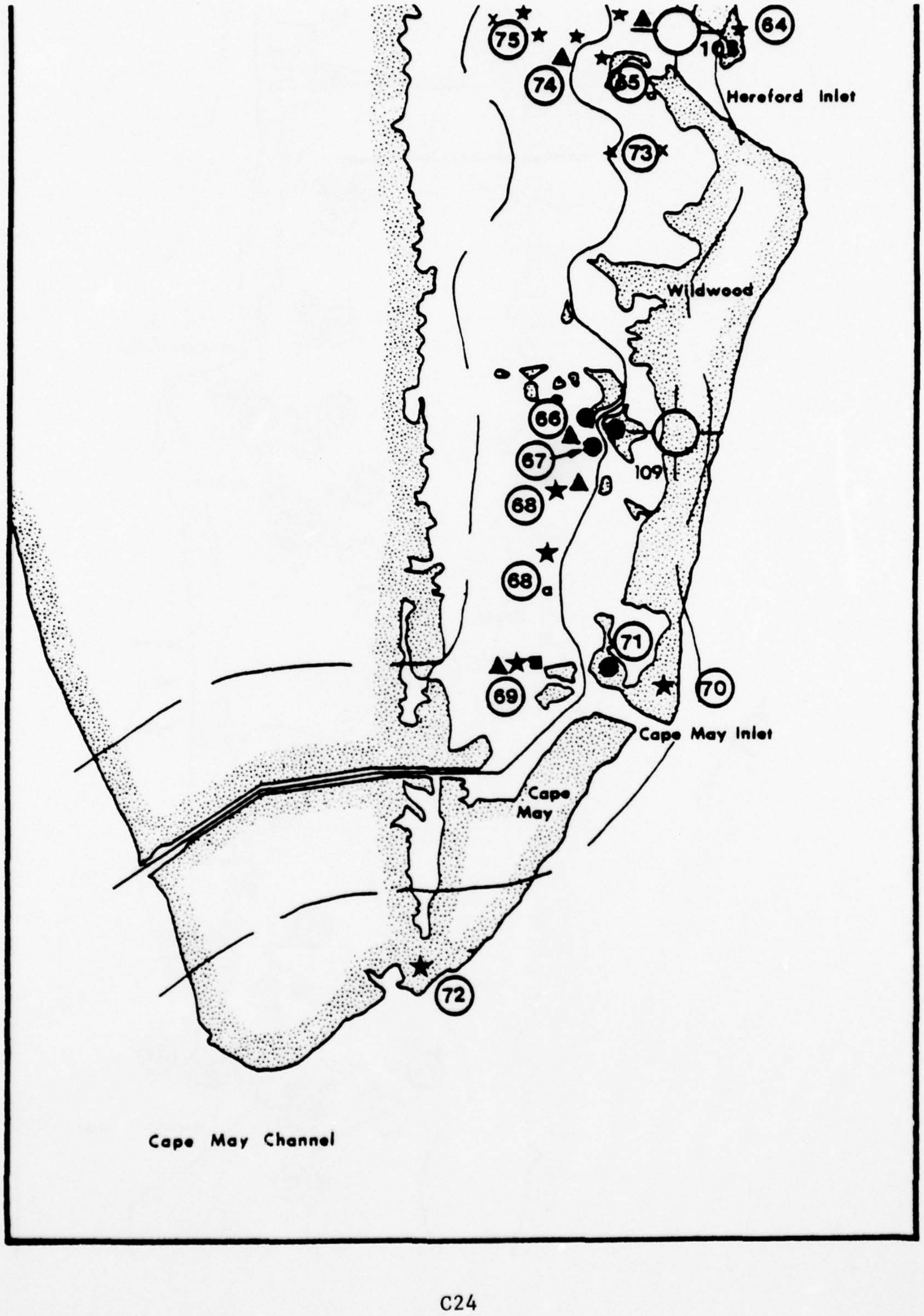
Stone Harbor
61
63
62
64
75
74
65
Hereford Inlet
73



75
74
65
64
108
Hereford Inlet
73
Wildwood
66
67
109
68
68a
71
69
70
Cape May Inlet
Cape May
72
Cape May Channel

APPENDIX D:

PHOTOGRAPHS OF THE 21 STUDY ISLANDS

Figure D1. Aerial view of Study Island A12

Figure D2. Aerial view of Study Island A12 North

Figure D3. Aerial View of Study Island A35

AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3
USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166
UNCLASSIFIED WES-TR-D-78-1 NL

3 OF 8
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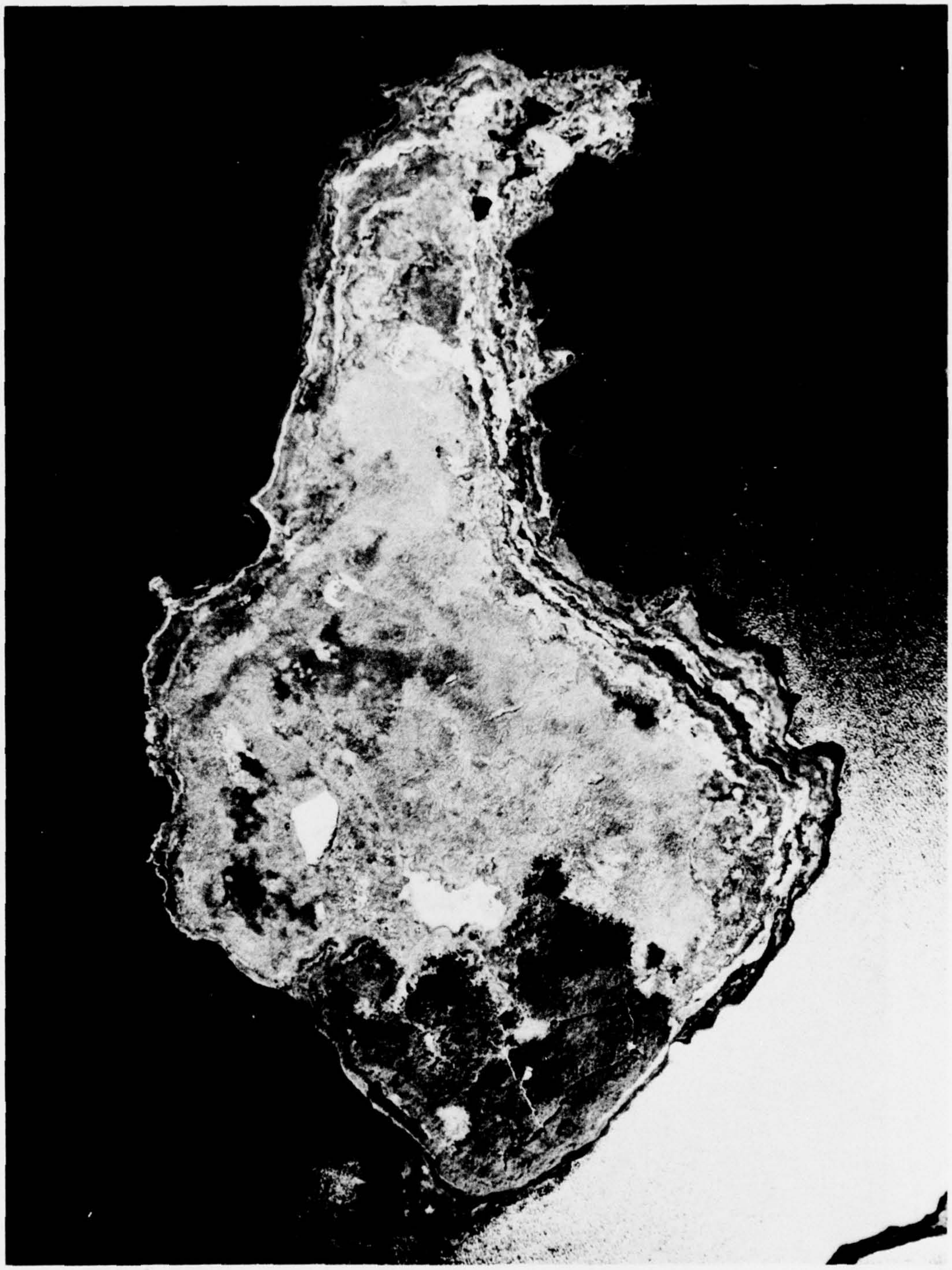

Figure D4. Aerial view of Study Island A43a

Figure D5. Aerial view of Study Island 45A

Figure D6. Aerial view of Study Island 45B

Figure D7. Aerial view of Study Island X27

Figure D8. Aerial view of Study Island 51B

Figure D9. Aerial view of Study Island A61c

Figure D10. Aerial view of Study Island A59a

re D11. Aerial view of Study Island 85dmi

Figure D12. Aerial view of Study Island 85 South

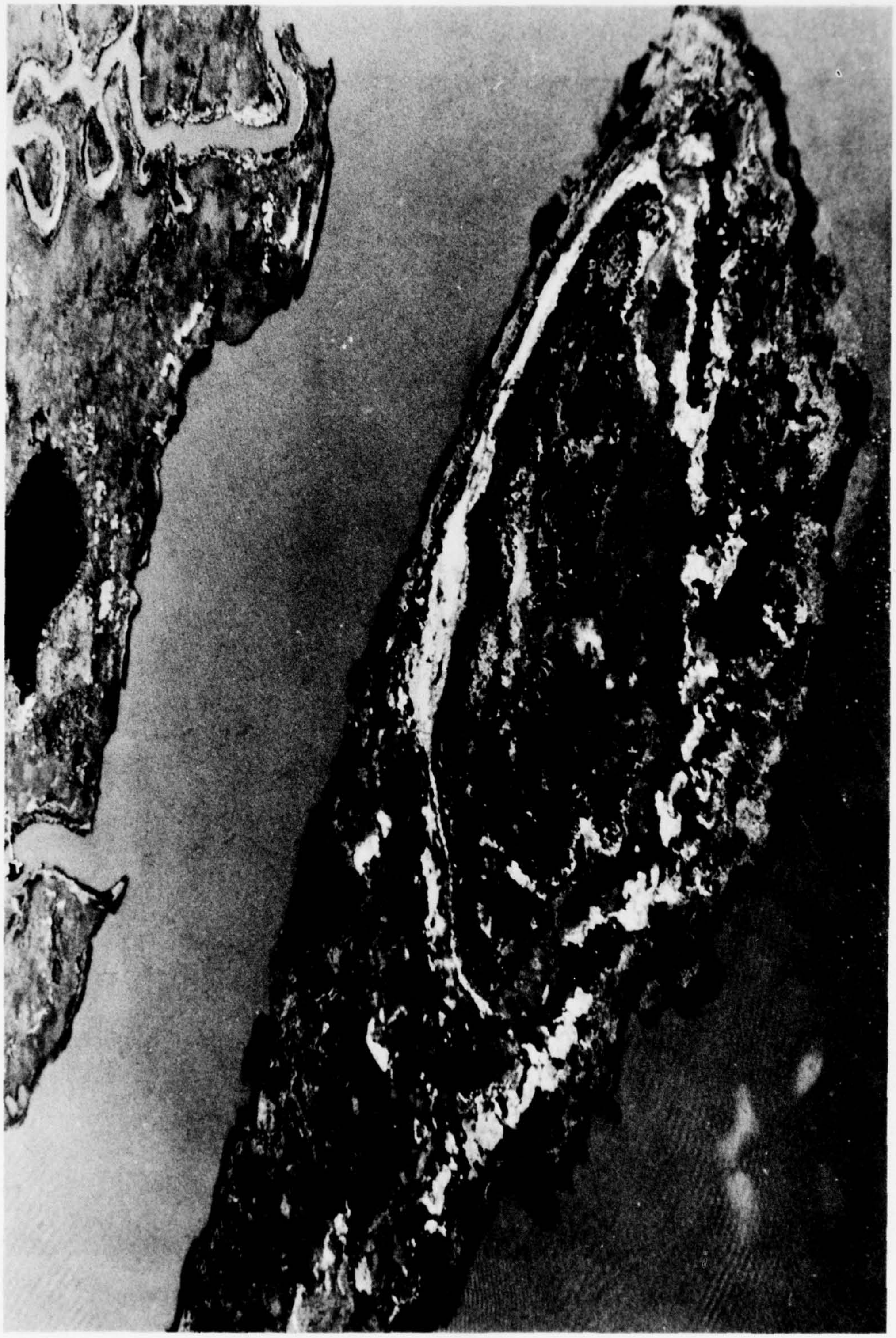

Figure D13. Aerial view of Study Island 98A

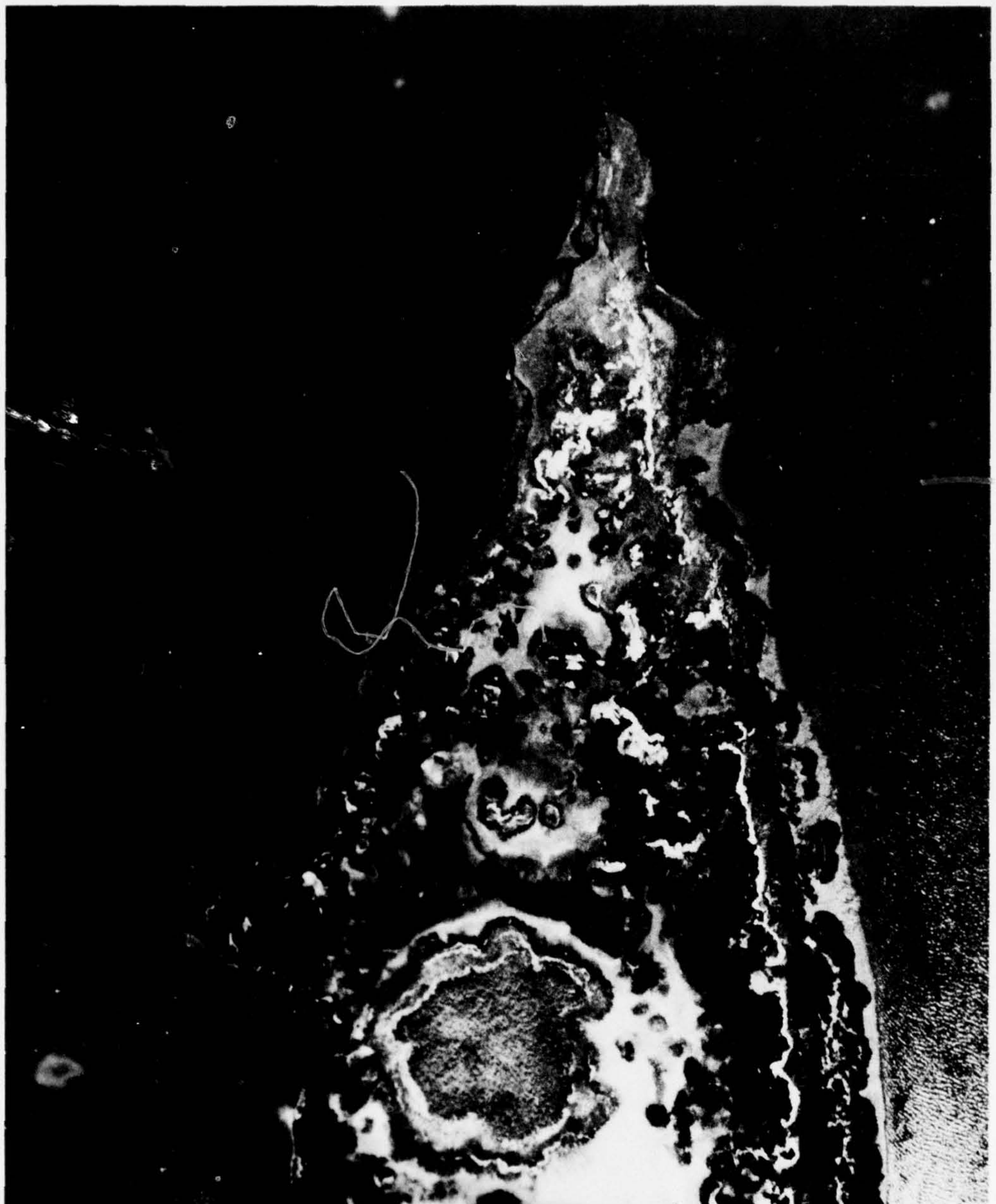

Figure D14. Aerial view of Study Island 108B

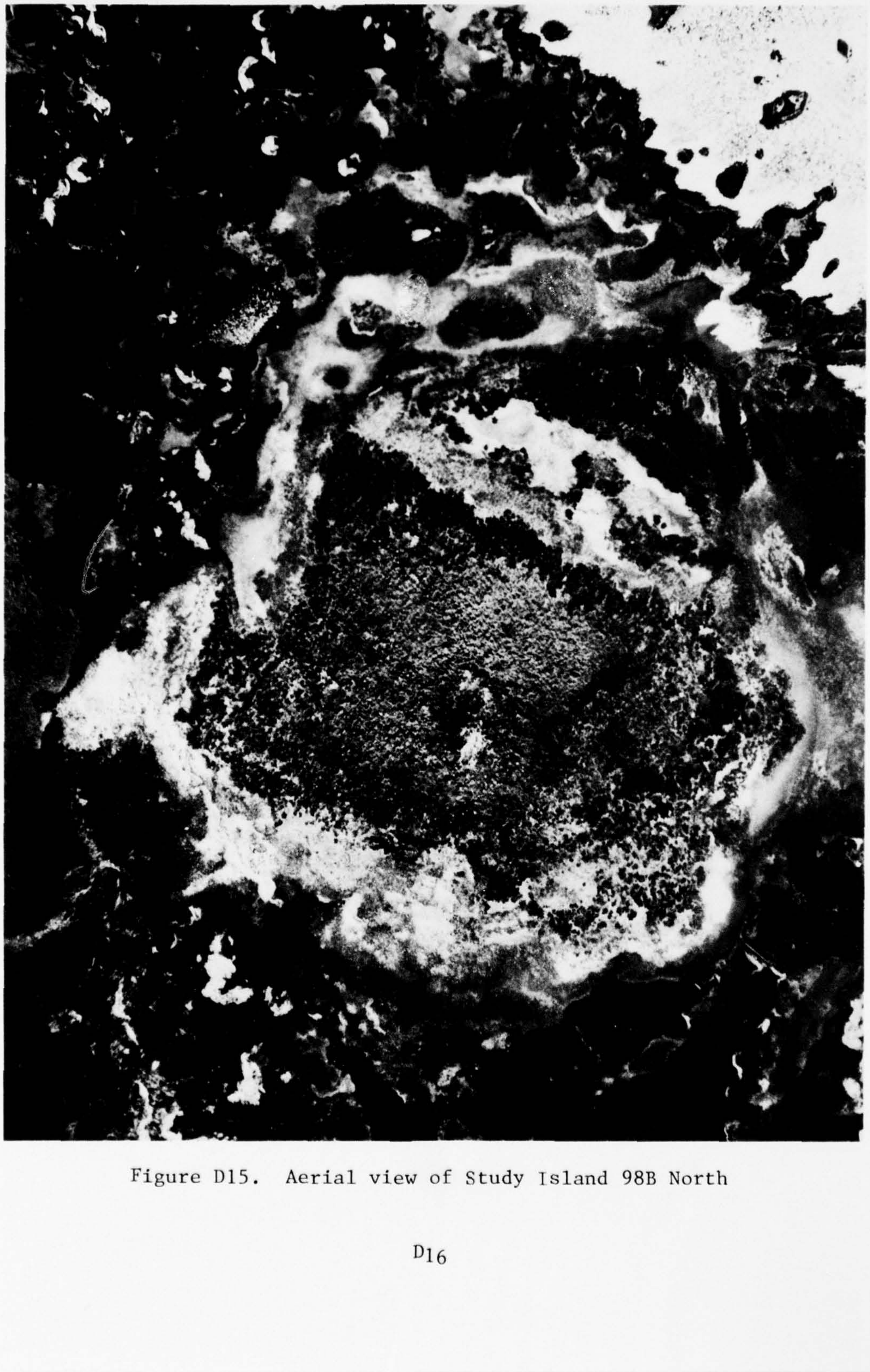

Figure D15. Aerial view of Study Island 98B North

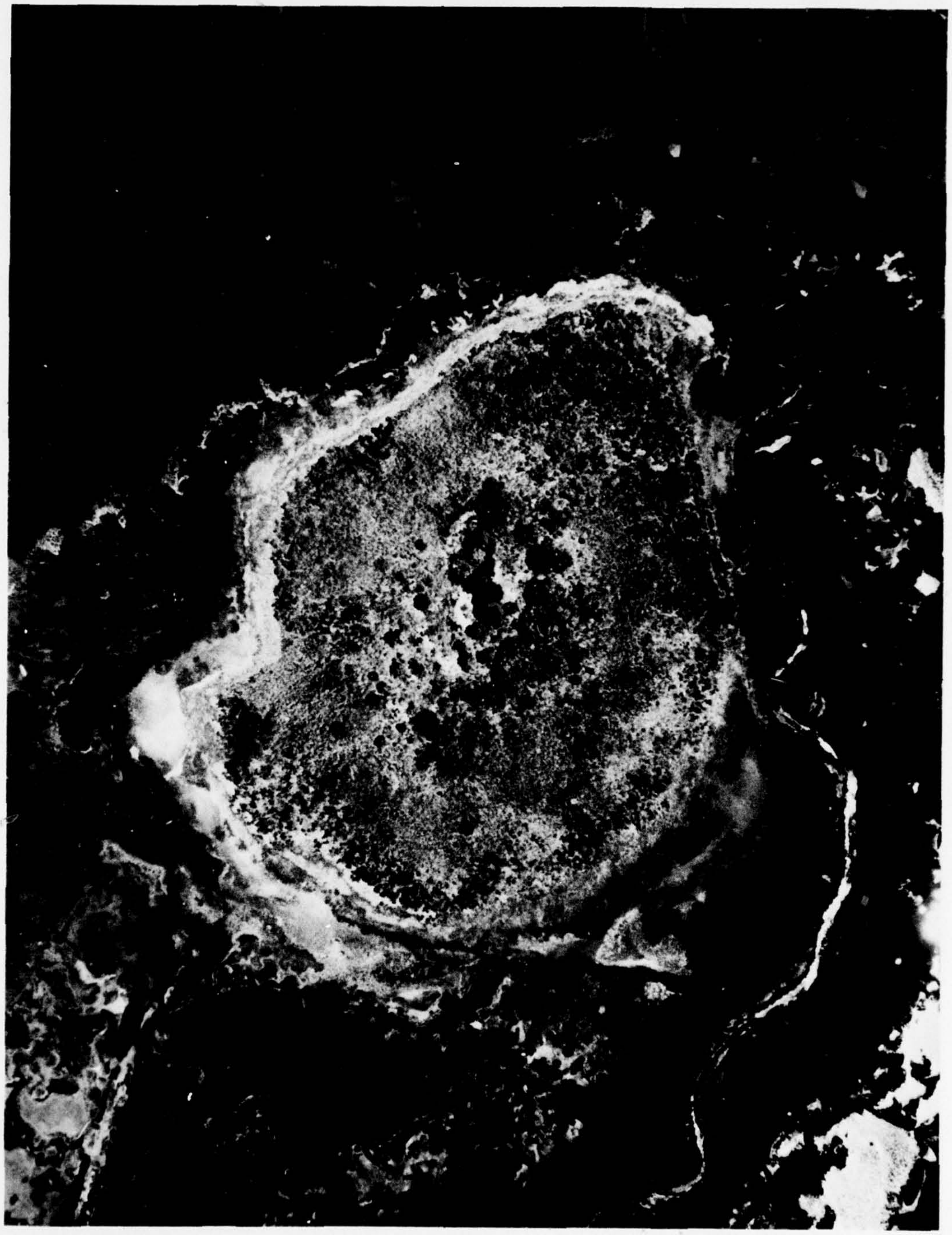

Figure D16. Aerial view of Study Island 98B South

Figure D17. Aerial view of Study Island 78B South

Figure D18. Aerial view of Study Island 103

Figure D19. Aerial view of Study Island 85C

Figure D20. Aerial view of Study Island 109

Figure D21. Aerial view of Study Island 109 South

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Use of dredged material islands by colonial seabirds and wading birds in New Jersey / by Francine G. Buckley, Cheryl A. McCaffrey, Manomet Bird Observatory, Manomet, Mass. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

157, [48] p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-1)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW39-76-C-0166 (DMRP Work Unit No. 4F01D)

Appendices A and B on microfiche in pocket.

Literature cited: p. 154-157.

1. Birds. 2. Dredged material. 3. Islands (Landforms). 4. New Jersey. 5. Seabirds. 6. Shore birds. I. McCaffrey, Cheryl A., joint author. II. Manomet Bird Observatory. III. United States. Army. Corps of Engineers. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-1.

TA7.W34 no.D-78-1

DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-1

USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY

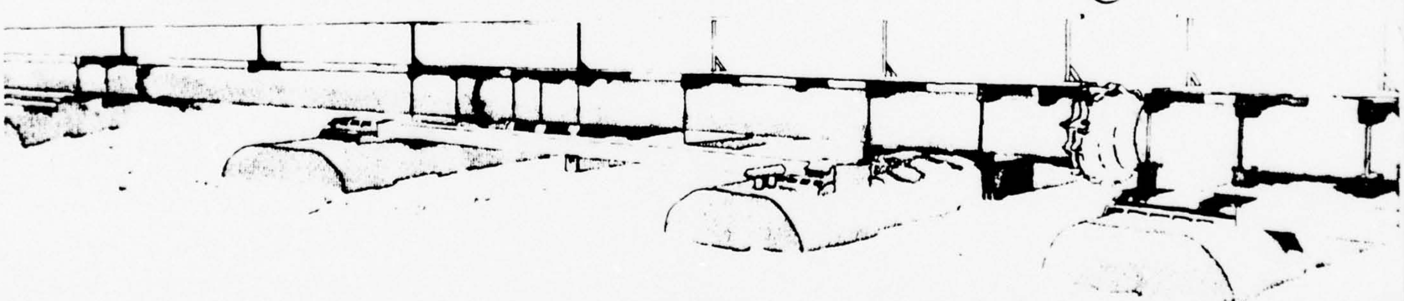
APPENDIX A: HISTORIC DATA FOR NEW JERSEY INTERCOASTAL WATERWAY

by

Francine G. Buckley

Manomet Bird Observatory
Manomet, Massachusetts 02345

January 1978
Final Report



Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under Contract No. DACW39-76-C-0166
(DMRP Work Unit 4F01D)

Monitored by Environmental Effects Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Mississippi 39180

ACKNOWLEDGMENTS

This report could not have been completed without help and cooperation from a number of persons. Thanks and appreciation are due them. The following persons deserve special acknowledgment as well.

Joanna Burger, Associate Professor, Rutgers University, allowed access to and the use of both published and unpublished field data in addition to participating in a number of very useful discussions. Richard Kane, New Jersey Audubon Society, made essential resources of the New Jersey Audubon Society Wildlife Research Unit available. He also provided invaluable information about their 1976 colonial bird survey activities.

Roger Clapp, Bird Section, National Bird and Mammal Laboratory, allowed access to the vast resources of the National Museum of Natural History, in addition to invaluable aid in locating obscure reference materials. Joan Galli, New Jersey State Non-Game Biologist, furnished very useful details about the workings of the New Jersey State Department of Environmental Protection. Michael Bartlett, U. S. Fish and Wildlife Service Biologist, was most helpful with information about Brigantine National Wildlife Refuge. R. Michael Erwin, Research Associate with the University of Massachusetts, Amherst, was generous with information about the U. S. Fish and Wildlife Service Colonial Waterbird Census Program in New Jersey.

Paul A. Buckley, Chief Scientist, North Atlantic Region, National Park Service and Regional Editor for the Hudson-Delaware Region of American Birds, provided many hours of discussion regarding population trends over the last thirty years for most of our colonially nesting species as well as editorial comments on this report. His patience during its compilation is also gratefully acknowledged.

While the author enthusiastically acknowledges the aid and cooperation received from the aforementioned persons, she reserves all blame for errors of commission or omission to herself.

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THE USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY

APPENDIX A: HISTORIC DATA FOR NEW JERSEY INTERCOASTAL WATERWAY

I. INTRODUCTION

This phase II Interim Report for "A Study of the Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey" deals with the historical aspects of these birds' nesting in New Jersey.

Information in the existing literature is limited and direct reference to avian use of known dredged material islands for any purpose is virtually non-existent. Thus the bulk of this report provides a history of these species throughout the entire state of New Jersey so that extrapolations can be made to dredged material islands.

The report is divided into several sections. The second through fifth sections briefly describe the general study area (New Jersey) and the present and past conditions of the specific study area (bounding the Intracoastal Waterway from Manasquan Inlet to Cape May Canal); existing available habitat and its preservation is discussed; available data sources from a historical perspective are described; a brief description of some of the considerations used in listing the types of sites used by colonial species and problems involved in their determination as being of dredged material origin is provided.

The body of the report provides a brief account of each species and its history as a breeder in New Jersey, followed by tables listing (1) breeding biology parameters for each species in New Jersey and (2) locations, dates, colony size, site types, references and breeding stage data when available. Supplemental data include tables and figures showing results from a 1975 U. S. Fish and Wildlife Service census of wading birds and a listing of colony site locations and colony composition of a 1976 New Jersey Audubon Society survey of colonial waterbirds keyed to a series of hydrographic maps with colony sites and dredged material areas designated upon them.

A complete bibliography which lists references and source materials used in the compilation of the entire Interim Report, as well as uncited references, comprises the final section.

II. DESCRIPTION OF AREA

The coast of New Jersey extends from the top of Sandy Hook Spit to the tip of Cape May Point. It is only along these 150 miles that the Atlantic Ocean meets New Jersey. The major area of interest in this report, the New Jersey Intracoastal Waterway, covers 117 of these miles, from Manasquan Inlet to the entrance of the CapeMay Canal. Except for a two mile portion of the canal connecting the Manasquan River with the head of Barnegat Bay, this is the area of New Jersey's barrier islands, barrier spits, coastal salt marshes (or salt meadows) and its major back bays and lagoons. It traverses three counties: Atlantic, Ocean and Cape May. The greatest diversity and habitat possibilities for the species that we are concerned with in this report are located here. The other areas of New Jersey, with the exception of Sandy Hook in Monmouth County, and the Hackensack Meadows in Bergen County, are either too heavily developed or unsuited to the ecological requirements of these species.

While several species in this study are (or, more properly, were) denizens of the barrier beaches, most are dependent on the famous New Jersey salt marshes for their food if not their nest sites. In 1954, the state boasted 241,060 acres of coastal wetlands. By 1968, 10.5% of these had been permanently destroyed and additionally uncounted acreage was also affected by pollution of various sorts (Robichaud & Buell 1973). While this might seem a slight amount, its proper impact appears when one considers that New Jersey has almost 10% of the total wetlands along the Atlantic Coast and more than half of those have been severely modified (Gusey 1976; Jacobson 1965; Crawford 1964). Within New Jersey, the most densely populated state in the U. S., salt marshes represent only 4.5% of the total acreage. Yet these marshes are vital for primary productivity supporting the state's finfish and shellfish industries and those of other east coast states as well. In addition, the marshes supply the food for large numbers of colonially breeding waterbirds discussed in this study. In former times most of these birds nested on the isolated barrier islands and fed in the equally

deserted marshes. Development of the beaches for recreational pursuits was accompanied by the removal of the vegetation and the freedom from disturbance and predation these birds needed for survival. In the 19th century the birds and/or their eggs were hunted for food and finally --- in the ultimate indignity --- slaughtered for vanity to decorate women's hats. Most of these species were extirpated from the state by the late 1800's and early 1900's. Fortunately, all have now recolonized their former breeding areas, though not in their former numbers.

The New Jersey salt marshes, aside from being polluted, have been most altered by the relentless ditching that was begun in the early 1900's. This was done in order to drain their rich, productive, shallow pools and pannes in order to control the infamous New Jersey mosquitoes (Stone 1937). At the same time various state, municipal and local bodies, as well as individual owners, began indiscriminate dredging and filling for navigation and other purposes. This created a variety of "high spots" in the marshes, the records for which have usually either never existed or have been lost. The changes in salt water flow, turbidity, temperature, tidal flux, salinity gradients and other factors that resulted (Clark 1972) must have had profound effects on the marine life inhabiting the marshes and in turn on their avian predators. Coming as these effects did --- almost simultaneously with hunting, the feather trade, and beach development pressures --- they could only have hastened the decline of these birds.

On the barrier islands the situation was hardly better. First came removal of the once extensive stands of maritime forests and coastal cedar swamps eliminating most of the coastal nesting sites of large heron colonies. Then as the beaches sprouted communities, at first summer-only and then year-round, man and his quadruped associates (cats, dogs, rats) invaded. In order to keep the barrier beaches and their newly acquired communities from periodically washing away during severe storms as they followed their natural landward progression in advance of an inexorably rising sea level, man stabilized inlets with jetties and beaches between inlets with smaller groins. Natural dunes were leveled and in some places artificial dunes were built. Many beaches

narrowed and could not replenish themselves naturally. By this time few birds were attempting to nest on the beaches. The large tern colonies were eliminated for feathers and the long, flat, shell, and pebble covered recurving spits so typical of naturally migrating inlets became a thing of the past in most cases. This then was the scene in the early twentieth century on coastal New Jersey.

Today the coast has undergone many changes. Proceeding northward from the Cape May Canal, the first barrier beach we reach is Wildwood, formerly called Five Mile Beach. It is now fully developed, being occupied by the communities of Cold Spring Harbor, Wildwood Crest, Wildwood and North Wildwood. Until the late 1890's it harbored the most magnificent hardwood and softwood forests of the entire New Jersey coast (Stone 1937). Crossing Hereford Inlet --- still unjettied and probably the best location for gulls and terns in southern New Jersey --- one reaches old Seven Mile Beach, now also fully developed by the communities of Stone Harbor and Avalon. The last remaining piece of maritime forest in the whole of southern New Jersey's barrier beaches is preserved here and is the site of the famed Stone Harbor Town Sanctuary, the largest heronry in New Jersey. North of Townsend's Inlet, above Avalon, lies old Ludlum's Beach, again fully developed by the communities of Townsend's Inlet, Sea Isle City, Whale Beach and Strathmere --- all mostly seasonal one-family houses, although year-round occupancy is increasing. North of Corson's Inlet is old Peck's Beach, the site of greater Ocean City. Development here is proceeding at a rapid pace, although the extreme south end of the island is isolated and more or less protected. It harbors numbers of feeding and resting terns and gulls, many of which nest on nearby bay islands. Jettied Great Egg Harbor Inlet separates Ocean City from Longport, and at the north end of former Absecon Beach is world famous Atlantic City. This is the most exploited and built up section on the entire New Jersey coast, and is almost unrecognizably barrier beach in origin with its extensive high-rise apartments and resort hotels. Absecon Inlet separates Atlantic City from its burgeoning suburb of Brigantine, but development has spared the northern half of Brigantine Island, which

except for rather heavy beach traffic, is still in essentially natural condition. Little Beach Island, next up the line after Absecon Inlet, is a Wilderness Area within Brigantine National Wildlife Refuge and is the last remaining fully natural barrier island on the entire New Jersey coast. Unfortunately it has apparently never harbored any significant maritime forest, and does not today. Oriented more NW-SE than N-S, it forms the southerly shore of exceptionally wide Beach Haven Inlet, on the north end of which is Holgate (also called Beach Haven). Recently (1960) made a part of Brigantine National Wildlife Refuge, this two mile piece is like Brigantine Island, a flat and treeless area still in a natural state. It has, however, been impacted by recreational use from the rest of Long Beach Island to which it is attached and which is heavily developed along its 18 mile length. To its north is Barnegat Inlet, a jettied major navigational cut on whose north side is Island Beach. This State Park preserves the longest (10 miles), controlled vehicular-access beach still in essentially natural condition in New Jersey. Blessed with some remaining maritime holly forest, although of small stature, Island Beach gives insight as to what most of the islands to the south must have looked like. From here north to Manasquan Inlet the coast is fully developed the entire last 25 miles to Sandy Hook. This 5 mile long spit is now preserved by the National Park Service in natural condition except for the remains of a military base and a few small parking lots. It harbors the largest extant holly forest anywhere on the U. S. Coast, one that formerly supported a large mixed species heronry. It is now reduced by aircraft and other disturbance to about 6 pairs of Great Blue Herons, and a growing Black Skimmer, Common and Least Tern Colony is now established directly on the beachfront with the only other beachfront colony known in 1976 being at Holgate.

Despite the intensive development of the barrier islands, the remaining marshes behind them are still comparatively undisturbed although mostly ditched. Dredging operations have produced a number of islands in the marshes and these, coupled with other "high spots" of undetermined origin throughout much of the south Jersey marshes, have

provided alternatives to the former nesting sites destroyed on the barrier islands. It is here that most of the species concerned with in this study are now found. Almost every acre of marshland has some breeding birds, though they tend to concentrate near the inlets where tidal swings cause upwellings and attendant increases in prey items. Even so, given two similar inlet configurations, one heavily used by people and the other more isolated, the latter will generally be chosen by birds for nesting.

III. HABITAT PRESERVATION

Habitat preservation in such a densely populated area is always a difficult problem and protected wildlife areas are few and far between on the New Jersey shore. The Stone Harbor Sanctuary for herons has already been mentioned, but it is a small area in a sea of development. Some of the inlet beaches are closed to beach buggies, but regulations and barricades are frequently flouted and circumnavigated. Brigantine National Wildlife Refuge's 29,000+ acres encompass the most significant chunk of coastal habitat in southern Jersey, including barrier beaches, bays, sounds, inlets, marshes and two square-mile freshwater impoundments. Island Beach State Park preserves another 10 miles of barrier spit but unfortunately no colonially nesting waterbirds. Sandy Hook's five miles (actually outside the specific study area) caps the meagre coastal protection. While ostensibly all colonial waterbirds are protected from disturbance by the Federal Migratory Bird Treaty Act and its amendments, as well as by New Jersey State laws, in fact they are harassed so much that colonies are forced to move with distressing regularity. Bird banders and photographers are, sad to report, prime offenders.

Most of southern New Jersey's colonial waterbirds have been forced to nest sites in the marshes where they are now probably safer from human disturbance than they have ever been though they are still faced with quadruped predation, tidal flooding and increasing recreational development.

New Jersey's Coastal Area Facilities Review Act (CAFRA) and its Coastal Zone Management (CZM) program will reduce and hopefully preclude most future marshland development and draining so these sites are reasonably well protected. Pollution is another matter and might also have played a key role in the desertion of the Sandy Hook heronry, as adjacent Raritan Bay is one of the most polluted estuaries on the east coast. It may not be coincidental that New Jersey's Black-crowned Night Herons and Great Egrets showed the highest DDE and PCB levels in a recent study (Clapp 1975). These species are not as numerous in New

Jersey as in years past, despite the overall increase in breeding herons in the state.

IV. DATA SOURCES

The history of ornithological investigations in New Jersey can be conveniently divided into everything up to and including Witmer Stone's monumental and classic Bird Studies at Old Cape May (1937) and data thereafter.

The earliest published information about New Jersey dates from the early 1800's and results from the visits of Alexander Wilson, J. J. Audubon and other early ornithologists. Their observations were mainly in the southern coastal areas of New Jersey, specifically the Cape May and Great Egg Harbor regions. Alexander Wilson made six excursions to New Jersey and spent four weeks with George Ord in the Spring of 1813 (Burns 1929). In 1829, J. J. Audubon stayed in the Great Egg Harbor area for three weeks. Their sketchy descriptions of their brief visits to these areas provide most of the early recorded information on birds in New Jersey. Records are scarce after the time of George Ord, Charles L. Boneaparte, Charles Townsend and the Baird brothers whose sketchy notes also contribute to most of our early information. In the mid 1800's, Giraud (1844) provides some information about N. J. in his Birds of Long Island. Some information was also available from notes on county lists by Krider (1879), a Cape May list in 1856 by T. Beasley, and another in 1869 by William P. Turnbull. In the 1880's enthusiastic egg collectors such as Harry Parker and Charles Shick (1890) left some notes on birds of their favored collecting areas along Seven Mile Beach and Sea Isle City areas.

Later records at the turn of the century and early 1900's were available from the activities of egg collectors, Turner McMullen and R. F. Miller, who were also very active field observers in New Jersey. Witmer Stone at this time (1894; 1909) began his documentation of avian populations in New Jersey. This coincided with the period that colonially nesting waterbird species had reached their nadir from the depredations of the plume hunters and the growth and development of the coastal areas.

The early 1900's saw the first efforts toward more systematic collection of data as observers --- many still shooting all they saw merely

to identify the birds --- began to record their observations at many south Jersey locations. The formation of the Linnaean Society of New York in 1878 and the Delaware Valley Ornithological Club (DVOC) in Philadelphia in 1890 established nuclei for systematic observations on birds of coastal New Jersey.

The activities of Linnaean Society members in the northern New Jersey area and Charles Urner in and around the marshes and meadows adjacent to the Elizabeth, Newark and Hackensack areas reinforced local ornithological interest in those areas. In the southern portions of the state, Witmer Stone, Julian Potter, Turner McMullen, Richard Miller and other DVOC members provide us with a picture of coastal bird life in the early 1900's to the 1930's.

By this time, the era of intensive gunning and collecting was ending but records as to location and numbers of our colonially nesting species were still sketchy. Many early 1900's records listed vague locations because the highly competitive egg collectors, sources of much early ornithological information, did not wish to reveal the exact locations of their favorite collecting sites. Existing records also seemed dependent upon the availability or access to certain areas and the proximity of qualified observers. There was never any well coordinated systematic effort to survey colonial nesters in New Jersey until recently and early data suffers accordingly.

By the late 1930's, extended auto trips by birders from New York and Philadelphia were commonplace. Major impetus for renewed work came with the publication of Bird Studies at Old Cape May in 1937. Regular summaries of avian events were then appearing in Bird Lore, as well as in the publications of the Linnaean Society and the DVOC. Greater field activity and mobility coincided with the return of several heron species as nesters to New Jersey. The first Great Egret nest was found in 1928 and the first nesting Snowy Egret since the 1800's was found in 1934. Birders, banders, a few eggers and photographers were actively seeking new colonies and breeding species. Herring Gulls were moving southward as breeders. Forster's and Gull-billed Terns were moving north along with the rapidly expanding heron populations, and shorebird and waterfowl

species were also increasing in coastal areas.

World War II cut short critical field observations in the early 1940's with severe travel and gasoline restrictions. Prohibitions were placed upon the use of binoculars along portions of the New Jersey coast to which the public had access. This resulted in a paucity of recorded information about bird life in New Jersey during the 1940's. After the war, greater mobility and the presence of an expanding highway system made one-day trips from New York and Philadelphia to Cape May and Brigantine feasible. The presence of Brigantine National Wildlife Refuge (established in 1939) and a growing heronry at Stone Harbor provided birders with an accessible destination rich in bird life. With the 1950's invasion of Cattle Egrets and Glossy Ibis to southern New Jersey, its fame spread as reports of its avian richness and diversity were published in Audubon Field Notes (later American Birds, and successor to Bird Lore). In 1955, the Urner Ornithological Club in Newark published the first book on the Birds of New Jersey (Fables 1955), an annotated listing of the species and their status occurring in the state.

Records in New Jersey were still spotty and unsystematic, in spite of the area's attraction to a large number of observers from nearby urban areas. Many birders had their favorite spots and only those were regularly covered. Few of these included dredged material islands. Extensive habitat destruction during this period forced many of the birds from more easily accessible beachfront locations back into the salt meadow areas which received little or no regular coverage. Even easily accessible Stone Harbor heronry was never censused on a regular basis. The expanding heron and ibis populations were comparatively well documented mainly because of the interest in Cattle Egret and Glossy Ibis expansion, especially when compared to tern and gull population documentation.

The need for accurately estimating population numbers of our colonial nesters was generally overlooked even by active field observers until recently. It was not until 1976 that any statewide survey-census of all colonial nesters was attempted under the sponsorship of the U.S. Fish and Wildlife Service (Kane & Farrar 1976). Lack of adequate funding precluded aerial surveying so that many areas were unsurveyed because of inaccess-

ibility. It was a major first effort and is the most complete available source of information presenting a recent picture of nesting locations and populations of these species in New Jersey.

A 1975 survey of the heron populations in New Jersey (Custer & Osborne 1975) was attempted by persons unfamiliar with the area and by fixed wing aircraft. Data from that survey is presented separately in Table 57 in spite of reservations about their adequacy.

Information about the habits of colonially nesting seabirds and wading birds on dredged material islands and their use of them in New Jersey is virtually nonexistent. The data on the various species' history in New Jersey and their breeding biology and habitat preferences are all drawn from references in the accompanying bibliography, from discussions with knowledgeable observers in New Jersey, and from the Principal Investigator's own experience. Application of these data to birds using dredged material islands will have to be by inference from already existing data. There is little reason to believe that these animals would behave differently or vary in their annual breeding cycles if they nested on dredged material islands rather than other locations.

V. SITE TYPE DETERMINATION

The portions of New Jersey dealt with in this study have been so greatly modified by human activities in the last 80 years that much of what exists today would be totally unrecognizable to earlier inhabitants of the area. The beaches have been leveled of dunes and forest. Salt meadows have been drained and filled, ditched or channeled. Inlets, streams and ponds have been filled or drained.

As a result of many of these activities, problems beyond the scope of this study remain in determining the exact origin of many of the islands that offer nesting sites to the colonially nesting species in New Jersey. Because of extensive beach development, habitat destruction, and/or competition with man for their nesting sites, the birds have been forced to move from their historic barrier beach nesting locations. They have relocated on islands in the salt meadows or marshes behind the beaches in the bays and inlets. The origin of many of these sites is obscured by the lack of records and the concurrent activities by private and public interests in draining, diking, dredging and filling of these marshes resulting, in some instances, in the creation of suitable nesting habitat for colonially nesting species. The exact origin of most of these islands is simply unknown (N.J. Dept. of Environmental Protection, pers. comm.) though opinions that "any high spot in the marsh is most likely of dredged material origin" seem acceptable to many.

Large-scale ditching operations by mosquito control authorities have created numerous high areas as well as have the dredging operations for navigation channels. Both activities have been carried out since at least the early 1900's. Vegetational growths of *Baccharis*, *Iva* and *Phragmites* present on many of these areas are merely indications of slight elevations --- not proof of island origin since these species do not grow in the wetter lower areas (Bourne & Cottam 1950). Thus the determination of island origin becomes difficult in the absence of extensive records and one can only surmise as to the origin of many of these islands without further extensive study of the sites themselves by such methods as coring. Unfortunately, this is beyond the scope of this project.

The designations of individual sites as dredged material or "spoil" are based upon references cited for each record in the following tables and may not be listed as dredged material islands in the records of the U.S. Army Engineer Philadelphia District, in the New Jersey State records or by the principal investigator.

VI. SPECIES ACCOUNTS

The colonially nesting wading bird and seabird species found breeding in New Jersey are listed on the following page. There are ten wading bird species, three gull species, five tern species and Black Skimmer currently nesting in New Jersey.

Individual species accounts follow this listing and each species account includes a general summary of historic and current species status in New Jersey and tables listing breeding biology parameters, 1976 nesting data, and nesting data prior to 1976. Colony size is indicated by N = number of nests; P = number of pairs; B = number of birds; incr. = increase; decr. = decrease; const. nos = constant numbers; and numer. = numerous.

LIST OF COLONIALLY NESTING SEABIRDS AND WADING BIRDS IN NEW JERSEY

SCIENTIFIC NAME	VERNACULAR NAME
Ardea herodias	Great Blue Heron
Butorides virescens	Green Heron
Florida caerulea	Little Blue Heron
Bubulcus ibis	Cattle Egret
Casmerodius albus	Great Egret
Egretta thula	Snowy Egret
Hydranassa tricolor	Louisiana Heron
Nycticorax nycticorax	Black-crowned Night Heron
Nyctanassa violacea	Yellow-crowned Night Heron
Plegadis falcinellus	Glossy Ibis
Larus marinus	Great Black-backed Gull
Larus argentatus	Herring Gull
Larus atricilla	Laughing Gull
Gelochelidon nilotica	Gull-billed Tern
Sterna forsteri	Forster's Tern
Sterna hirundo	Common Tern
Sterna dougallii	Roseate Tern
Sterna albifrons	Least Tern
Rynchops nigra	Black Skimmer

A. Great Blue Heron
Ardea herodias

Our largest heron, the Great Blue is dangerously declining as a nesting species in New Jersey, especially along the coast (P. A. Buckley pers. comm.). It seems to be suffering greatly from habitat loss as well as human disturbance (Werschkul et al. 1976) especially in its coastal breeding locations and in 1976 only 17 birds were seen at 3 coastal sites. The Sandy Hook Colony (as large as 100 pairs in 1957) was down to only three or four pairs in 1976. It is believed that one factor contributing to its greatly reduced numbers at Sandy Hook was increased and changed jet aircraft approaches to New York City airports in the late 1950's (P. A. Buckley pers. comm.). This species also seems sensitive to human disturbance and one small colony disturbed by banders in 1959 did not return to the dredged material island it had been nesting upon.

The presence of these birds as breeders was first noted by Alexander Wilson on a visit to a Cape May white cedar swamp in May 1813. His description of 10-15 pairs "at the tops of the tallest trees" was for a long time the only recorded description of a Great Blue Heronry and was quoted by others such as Giraud (1844) and Bent (1926). In spite of the loss of these cedar forests to lumbering by the 1860's, it is thought that this area was still frequented by breeding Great Blues in 1892, 1894 and 1906 (Miller 1943).

Miller's account of the Great Blue Heron in New Jersey is one of the most complete, and he lists 26 historically known breeding sites, but by 1943 only four of these sites were still active. Seven abandoned sites were on the coast. By 1976, only four sites in New Jersey were reported to have had breeding pairs and of the two sites listed in the N.J.A.S. survey as "spoil" only one bird was observed at each. Since most of the heronries listed by Miller are no longer active and are inland sites, only the major ones are listed in Table 2. For a more complete historical description the reader is referred to Miller's excellent article. These locations are, however, indicated in Fig. 1.

Although the Great Blue Heron escaped destruction from the plume

hunters of the 1880's, it was heavily sought after for its eggs and flesh. It was highly regarded by sportsmen as a worthy opponent and its flesh was greatly esteemed and considered a delicacy by Giraud (1844). It was also used as an item of decoration through taxidermy and at one point in the early 1900's its tendons were used as surgical sutures (Miller 1943). Egg collectors collected its eggs to the point of absurdity, one collector alone having 1,137 eggs in his collection. Stone (1937) describes these herons as common on the salt meadows behind the barrier islands (both pre- and post-breeding) where food supplies were plentiful. He lists is as a common summer resident, occasionally overwintering (Stone 1894). Fables (1955) describes it as "a local breeder in scattered rookeries, mostly in the southern part of the state," and as overwintering near open water along the coast.

It is unlikely that we will have Great Blue Heron as a nesting species in the specific study area in 1977, mainly because of the lack of suitable habitat and too much human disturbance. It was included in this report only for purposes of completeness and because it has nested in the past in association with the other more numerous colonial waders.

TABLE 1.

SPECIES: Great Blue Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	25 February 1922		30 March 1925	25 da.	28 April 1935	10 June 1939
AVERAGE	late March-early April		early April-May	28 da.	May-June	late June
LATE	late April		3 June 1909	29 da.	late June-early July	mid July

REFERENCES: Bent 1926
Bull 1964
Giraud 1844
Miller 1935; 1940
Pratt 1970
Stone 1894; 1937

TABLE 2.

SPECIES: Great Blue Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Pomona	19 Aug	95N	mainland/ woods		x	N.J.A. Nov. 1976
Sandy Hook	9 Jun	6P	mainland/ woods	5 nests, eggs, incub.	x	Buckley & Buckley 1976
Sandy Hook	15 Jun	15B	mainland/ woods	3 nests, eggs, incub	x	Kane 1976
Sandy Hook		3P	mainland/ woods			Wander 1977
Shaw Cutoff	1 Jun	1B	"spoil bank"/ trees, shrubs			Kane 1976
Stingaree Pt.	1 Jun	1B	"spoil bank"/ trees, shrubs			Kane 1976

TABLE 3.

SPECIES: Great Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Auburn Salem Co.	1887 29 Apr	300-400P	mainland/ mixed woods			Miller 1943
Barrens Salem Co.	1889		mainland/ mixed woods			Miller 1943
	1896	124N	pines		x	Miller 1943
	1898-1901			eggs collected	x	Miller 1943
	1910			eggs collected 3 Apr & 23 Apr	x	Miller 1943
Five Mile Beach Cape May Co.	1892	fewP	beach			Miller 1943
Great Swamp Morris Co.	1974	30-35P	mainland			NJNN Dec. 1974
Hackettstown Warren Co.	1975	80P	mainland	nested successfully		AB Oct. 1975
Islajo Atlantic Co.	1959		island	5 young banded		Adams & Miller 1975
Island Beach Ocean Co.	1951 17 Jun	4B	barrier is.	nesting		AFN Oct. 1951
Jeffries Landing Atlantic Co.	1940	10N				Miller 1943
	1941	10N	tall oaks		x	Miller 1943

(continued)

TABLE 3. (continued)

SPECIES: Great Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Lafayette Sussex Co.	1955	30N	mainland			AFN Oct. 1955
	1959	1/2		occupied nests	x	AFN Aug. 1959
	May 1960	full 27B		nests	x	NJNN JUNE 1960
	9 Apr 1969	27N		nests	x	NJNN June 1969
	17 Mar 1975	68P		successfully nested	x	AB Oct. 1975
Makepiece Res. Atlantic Co.	1919	66N	flooded meadow/ white cedars	young	x	Miller 1943; Stone 1937
	1 Jun 1927	27N		eggs	x	Miller 1943; Stone 1937
	9 Apr 1927-1931	70P			x	Miller 1943
	1935	21N		young	x	Miller 1943; Stone 1937
	4 May 1936	17N			x	Miller 1943; Stone 1937
	17 May 1938	7P			x	Miller 1943
Marshalltown (Frogtown) Salem Co.	1917	12N	swamp/ red maples	eggs	x	Stone 1937
	15 Apr 1918	20N		eggs	x	Miller 1943; Stone 1937
	28 Apr 1920	40N			x	Miller 1943
	1921	40N		eggs	x	Stone 1937
	10 Apr 1922	12N		eggs	x	Stone 1937
	8 Apr					

(continued)

TABLE 3. (continued)

SPECIES: Great Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Marshalltown [Frogtown] Salem Co.	1925	15N	swamp/ red maples	eggs	x	Stone 1937
	12 Apr 1934	96N			x	Miller 1943
	1936	126N			x	Stone 1937
	29 Mar 1938	200P			x	Miller 1943
	1941	100N			x	Miller 1943
	1942	45N			x	Miller 1943
	1943	30+N	1-2 oaks		x	Miller 1943
N. Cape May Co.	1950 Jun	35N		nesting		AFN Oct. 1950
Paulsboro Sussex Co.	1947 9 Jul	2B	mainland	nesting		AFN Sept. 1947
Palermo Cape May Co.	1938 8 May	10N	meadows/ pines			Miller 1943
Pennsville Salem Co.	1896 2 May	30+N	wooded swamp/ giant pin oak	eggs	x	Miller 1943; Stone 1937
	7 May			young	x	Stone 1937
	1897-1909			eggs collected	x	Miller 1943
	1921	23+N			x	Miller 1943
	1925	4N			x	Miller 1943

(continued)

TABLE 3. (continued)

SPECIES: Great Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Pennsville	1926	1B	wooded swamp/		x	Miller 1943
Salem Co.	29 Mar	1N	giant pin oak		x	Miller 1943
Pine Barrens	1925 30 Mar	50+B	white cedar swamp	nests, territory defense	x	Stone 1937
	1928 10 May			eggs, incub.	x	Stone 1937
	1930 29 Jun			fledged	x	Stone 1937
Pomona Atlantic Co.	1968 mid Apr	20P	mainland			AFN Aug. 1968
	1969 29 May	30N		yng. newly hatched-fully grown	x	AFN Aug. 1969
	1970 16 Apr	30N		grew to 50 nests	x	NJNN June 1970
	1973	50P			x	NJNN Dec. 1973
	1974	55N		all active nests	x	AB Oct. 1974
Sandy Hook Monmouth Co.	1957	100P	mainland/ mixed woods	all active nests	x	AFN Oct. 1957
	1962	30+P			x	Bull 1964
	1974 11 Jun	14P		nests, eggs, young	x	Buckley & Buckley 1974
	3 Jul	4N				NJNN Dec. 1974
	1975 11 Jun	8P		nests, eggs	x	Buckley & Buckley 1975

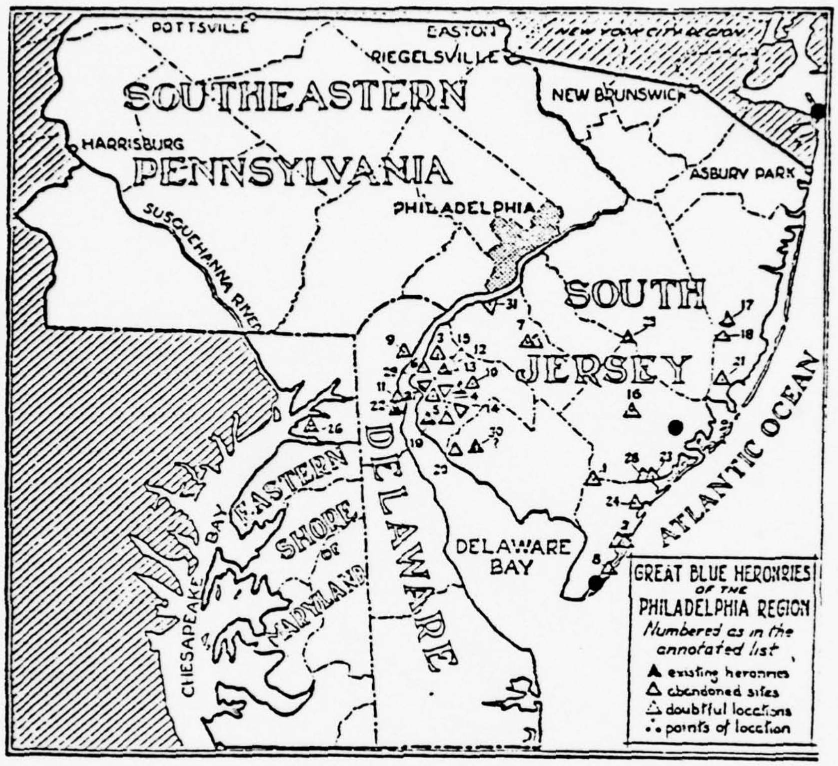
(continued)

TABLE 3. (continued)

SPECIES: Great Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Scullville Atlantic Co.	1937	32N	swamp/ old sweet gums		x	Miller 1943
	1938	10P			x	Miller 1943
	1939					
Seven Mile Beach Cape May Co.	1886	12+B	barrier is./ pitch pines		1885	Miller 1943; Stone 1937
Tuckahoe R. Cape May Co.	1813 18 May	10-15P	white cedar	1st. description in North America	x	Wilson 1813; Miller 1943
Tuckerton Ocean Co.	1935	15-20N	white cedar		x	Miller 1943

(concluded)



from Miller, 1943

△ colonies to 1943

● colonies in 1976

FIGURE 1. Great Blue Heron Colony Sites

B. Green Heron
Butorides virescens

The Green Heron has always been regarded as a common summer resident throughout New Jersey (Griscom 1923; Stone 1937). Fables (1955) recorded it as breeding in a variety of localities throughout the state, from low bayberry thickets on the coast to inland white cedar swamps (Stone 1937). The Green Heron is generally not considered a colonial nester and is customarily found in small colonies of up to six pairs or single pairs and not uncommonly in or near mixed species heronries (Stone 1937; Bent 1926). Baird et al. (1847) stated that it is unusual for "even two pairs to be nesting in company" and they remark upon Wilson's observations of "companies" nesting.

The large numbers recorded as nesting at Seven Mile Beach in the 1880's described by Parker and Shick in Burns (1929) defy imagination for those familiar with Green Herons today. No other sources describe such large numbers nesting together. [Several authorities doubt the correctness of the identification of these birds as Green Herons and suggest that they are referring to Black-crowned Night Herons instead (P.A. Buckley pers. comm.).].

In 1975, 116 adults were noted on the coast by the fixed-wing aircraft survey (Custer and Osborn 1975) but in 1976, the New Jersey Audubon Society found only 8 birds on their coastal survey (Kane and Farrar 1976). This discrepancy might be due to differing opinions as to whether they should have been counted at all.

Green Herons were not as reduced by the plume trade as were the other herons but birds and eggs were considered good eating and they were common items of diet in the 1800's and early 1900's.

They will probably not be a major consideration in the specific study area in the 1977 nesting season.

TABLE 4.

SPECIES: Green Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	early April		late April		late May	early July
AVERAGE	mid-late April		late May	17 da.	early June- early July	mid July
LATE	late April		early July		late July	August

REFERENCES: Bent 1926
Stone 1937
Urner 1929-30

TABLE 5.

SPECIES: Green Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Cape May Inlet	6/1	4B.	barrier is./ trees, shrubs			Kane 1976
Shaw Cutoff	6/1	3B.	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	6/2	1B.	barrier is./ trees, shrubs		x	Kane 1976

TABLE 6.

SPECIES: Green Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1972 21 Jul	.	island/ mixed heronry	eggs		J. Miller 1973
Avalon	1935 11 May			eggs		Miller 1935
	1941 25 May			eggs	x	Miller 1941a
Islajo	1959		island	3 week old yng. (17)		Adams & Miller 1975
	1963			3 week old yng. (13)	x	Adams & Miller 1975
	1964			3 week old yng. (11)	x	Adams & Miller 1975
	1965			3 week old yng. (13)	x	Adams & Miller 1975
	1966			3 week old yng. (23)	x	Adams & Miller 1975
	1967			3 week old yng. (11)	x	Adams & Miller 1975
	1968			3 week old yng. (10)	x	Adams & Miller 1975
	1969			3 week old yng. (19)	x	Adams & Miller 1975
	1970			3 week old yng. (6)	x	Adams & Miller 1975
	1972			3 week old yng. (13)	x	Adams & Miller 1975
Island Beach	1951 17 Jun		barrier is./	nesting		AFN Oct. 1951

(continued)

TABLE 6. (continued)

SPECIES: Green Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Peermont	1938 26 Jun			eggs		Miller 1939
Seven Mile Beach	1887	600-700P	barrier is.		x	Burns 1929
	1888	250P			x	Burns 1929
	1894	1P			x	Burns 1929
	1913 3 May	2N		eggs, hatching	x	Stone 1937
	1915 30 May	8N		eggs, some pipped	x	Stone 1937
	1916 4 Jun	3N		eggs	x	Stone 1937
	1919 30 May	6N		eggs, some pipped	x	Stone 1937
	1920 31 May	5N		eggs, young	x	Stone 1937
	1921 12 Jun	7N		eggs, young	x	Stone 1937

(continued)

TABLE 6. (continued)

SPECIES: Green Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1922	3N	barrier is.	eggs, young	x	Stone 1937
	21 May					
	1922	7N		eggs, young	x	Stone 1937
	17 Jun					
	1923	3N		eggs, pipped eggs,		
	8 Jun			young	x	Stone 1937
	1924	3N		eggs	x	Stone 1937
	18 May					
	4 Jul	6N		eggs	x	Stone 1937
	1925	4N		eggs, young	x	Stone 1937
	7 Jun					
	1927	20P			x	Stone 1937
	May					
	3 Jul	1N		eggs	x	Stone 1937
	1928	3N		eggs	x	Stone 1937
	26 May					
	24 Jun	1N		eggs	x	Stone 1937

(continued)

TABLE 6. (continued)

SPECIES: Green Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1929 2 Jun	3N	barrier is.	eggs	x	Stone 1937
	1932 26 Jun	5N		eggs, young	x	Stone 1937

(concluded)

C. Little Blue Heron

Florida caerulea

Little Blue Herons were recorded as breeding north to New Jersey by Baird et al. (1884), Bent (1926) and by Wilson (1813) who described nests in an area which is now Ocean City. He found them on May 19, 1812 at the tops of red cedars where they were nesting in a mixed colony of Snowy Egrets, Night Herons and Green Herons. He shot two adults and inspected two nests which held five eggs each. Stone (1894) called the species a rare straggler from the south. Stone (1937) states that by 1917, familiarity with the species in southern New Jersey was mainly with the post-breeding-season-dispersed white plumaged immatures in August and September; few blue plumaged adults were seen although they were increasing in the 1920's (Urner 1929-1930). Little Blue Herons had bred on some of the New Jersey barrier islands to the 1880's but were severely affected by the millinery slaughters in addition to having been regularly hunted and eaten as a game bird. The loss of colony sites in the New Jersey coastal forests probably also hastened their demise in New Jersey in the late 1800's and early 1900's.

A large heronry of Black-crowned Night Herons and Little Blue Herons (100 pairs) was discovered near Milford, Delaware in 1930 and it was believed that this had been the source of the increasing numbers of immatures and adults appearing in the Cape May area in the late 1920's. In 1935 in an inland mixed heronry, which consisted of 50 pairs of Black-crowned Night Herons and 10 pairs of egrets, 4 pairs of Little Blue Herons were also found nesting. Their numbers increased to 10 pairs in 1936 (Stone 1937).

Cruickshank (1942) lists the species as nesting regularly as far north as southern New Jersey and Fables (1955) records it as a local nester in the southern part of New Jersey but well distributed on ponds, marshes and streams throughout New Jersey. Bull (1964) records Little Blue Heron as a numerous nester in southern New Jersey.

More recently, the breeding numbers of Little Blue Heron seem to be decreasing from previous high counts reached in the 1950's and 1960's

(Clapp 1975). The large post breeding concentrations that appeared throughout the area beginning in the late 1920's (Urner 1929-1930) and peaking in the late 1940's and early 1950's (Seibert 1951, P.A. Buckley pers. comm.) have also decreased. Occurring in this period were large post-breeding roosts in New Jersey such as one that consisted of over 750 Little Blue Herons, at the southern end of Ocean City, Cape May County in 1949 (Seibert 1951). In 1948 and 1949, Little Blue Herons were the most numerous species in this roost of cherry trees only 15 feet high, which contained some of the largest concentrations of Little Blue Herons described in the New Jersey literature, though it included mostly immature birds, some of which Seibert may have confused with Snowy Egrets. One of the largest breeding concentrations found, however, occurred nearby on April 29, 1948; two rookeries were censused at Seven Mile Beach and 400 Little Blue Herons were found nesting in a mixed colony with Snowy Egrets (8), Black-crowned Night Herons (6) and 1 Louisiana Heron. This was probably near the August roosting area (if not the same site) though no specific locations were noted (AFN August 1948).

More recently the 1975 fixed-wing aircraft survey recorded 486 adults in New Jersey (Custer and Osborn 1975) but Burger (1977a) recorded 331 pairs in one colony alone. The 1976 N.J.A.S. survey (Kane and Farrar 1976) records only 164 adults but they had limited access to some areas so this is most likely a low figure.

The decrease in Little Blue Herons may be due in part to increasing competition at the nesting site from more aggressive species such as Snowy Egrets (P.A. Buckley pers. comm.) and Cattle Egrets (Dusi and Dusi 1968; 1970), both of which have increased as breeders in recent years in New Jersey.

Little Blue Herons have nested on dredged material islands in the specific study area and will probably be included for further study in the 1977 field season.

TABLE 7.

SPECIES: Little Blue Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY			late April		mid May	June
AVERAGE	late April		8 May-23 May		May-June	July
LATE			July		August	August

REFERENCES: Adams & Miller 1975
Burger 1977a
Cassinia 1947-1948
Dusi 1967
Stone 1937

TABLE 8.

SPECIES: Little Blue Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	20B	barrier is./ trees, shrubs	downy & feathered young	1975	Kane 1976
Cape May Inlet	1 Jun	2B	barrier is./ trees, shrubs			Kane 1976
Cornell Harbor	3 Jun	1B	"spoil bank"/ trees, shrubs	incub., hatching downy young	1975	Kane 1976
Cowpens Is.	4 Jun	3B	"spoil bank"/ shrubs	incub.	1975	Kane 1976
Flat Is.	7 Jun	4B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Goosebar Sedge	6 Jun	5B	"spoil bank"/ shrubs		1975	Kane 1976
Gull Is. Thoro	5 Jun	40B	"spoil bank"/ lo shrub, Phrag		1975	Kane 1976
High Is.	7 Jun	5B	"spoil bank"/ shrub, Phrag			Kane 1976
Middle Is.	6 Jun	27B	"spoil bank"/ lo shrub	downy young	1975	Kane 1976

(continued)

TABLE 8. (continued)

SPECIES: Little Blue Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Pork Is.	4 Jun	1B	"spoil bank"/ shrubs	incub.		Kane 1976
Shaw Cutoff	1 Jun	2B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stingaree Pt.	1 Jun	3B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	2 Jun	51B	barrier is./ trees, shrubs		x	Kane 1976

(concluded)

TABLE 9.

SPECIES: Little Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1972 21 Jul		island	nests, eggs, yng. in & out of nests by 19 Aug		J. Miller 1973
Camden vic.	1935 9 Jun	4P	BCNH col.	young	*	Stone 1937
	1936 6 Jun	10P	red maple swamp	downy young	x	Stone 1937
Camden vic. Fish House	1956 3 Jul	10P	mainland			AFN Oct. 1956
Cape May	1941 8 Jun			5 fledglings		Miller 1941a
Cobbs Is. Salem Co	1941	12P	sm. island/ shrubs			Miller 1943
Gull Is.	1970 17-23 May	300B	island/ mixed col.	incub., young.		NJNN Sept. 1970
Islajo	1975	331P	"spoil Is."	nested	x	Burger 1977a

* first nesting in New Jersey since the 1800's

(continued)

TABLE 9. (continued)

SPECIES: Little Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Islajo	1959		island	3 week old young (11)		Adams & Miller 1975
	1963			3 week old young (59)	x	Adams & Miller 1975
	1964			3 week old young (39)	x	Adams & Miller 1975
	1965			3 week old young (20)	x	Adams & Miller 1975
	1966			3 week old young (176)	x	Adams & Miller 1975
	1967			3 week old young (238)	x	Adams & Miller 1975
	1968			3 week old young (208)	x	Adams & Miller 1975
	1969			3 week old young (212)	x	Adams & Miller 1975
	1970			3 week old young (69)	x	Adams & Miller 1975
	1971			3 week old young (108)	x	Adams & Miller 1975
	1972			3 week old young (239)	x	Adams & Miller 1975
Island Beach	1951 17 Jun	20B	barrier is./ mixed col.	nesting		AFN Oct 1951
Little Heron Is.	1975	208P	"spoil is."	nested		Burger 1977c
Paulsboro	1947 9 Jul	21B	mainland	nesting		AFN Oct. 1950
	1950 15 Jul	164B		nesting	x	AFN Oct. 1950
Seven Mile Beach	1890	fewP	barrier is./ cedar grove			Shick 1890

(continued)

TABLE 9. (continued)

SPECIES: Little Blue Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1948 29 Apr	400B	in 2 mixed col.	nesting		AFN Aug. 1948
Somer's Beach (Ocean City)	1812 19 May	4B	red cedars	eggs	*	Wilson 1813
Stone Harbor	1946 10 Aug		barrier is.	eggs, newly hatched young		Cassinia 1947-1948
	1947 16 Apr	137B			x	AFN July 1947
	1950	decr.			x	AFN Oct. 1950
	1971 10 Apr	93B		nesting	x	NJNN Sept. 1971
Wildwood	1941 8 Jun			2 week old young		Dusi 1967
	1949 29 May			2 week old young	x	Dusi 1967

* first recorded nesting in New Jersey

(concluded)

D. Cattle Egret

Bubulcus ibis

Cattle Egret is the most recent addition to the list of herons breeding in New Jersey. An Old World species, it expanded its range naturally to the New World (Crosby 1972), first to South America and then suddenly appearing in Florida, Illinois, New Jersey and Massachusetts (where a bird shot in April is now considered to be the first North American record) during April-August 1952 (Griscom 1952). It was, however, observed in Florida in 1942 (Fowler 1958).

In New Jersey it was first found at a farm in West Cape May by R. Smart, J. Baird and B. Bates on May 25, 1952, (AFN August 1952). The bird was in full breeding plumage and was following cows and picking up insects. Julian Potter observed two birds on June 3, 1952 at the same location. Numbers increased gradually and 36 adults were counted in 1958 on an Audubon Survey by H. Mills and R. Allen when several adults carrying nesting materials into the Stone Harbor heronry also were seen. Young birds were later reported on July 11 of that year. During the same season the first nests were located at Stingaree Point, near Wildwood, by R. Fowler and R. Lyons.

The species continues to expand, now nesting as far north as Maine and Canada, but not in great numbers. By 1960, 200-300 birds were counted roosting at Stone Harbor.

The 1975 fixed wing survey recorded only 44 adults but Burger (1977a, 1977c) reported 85 pairs at two locations in 1975. The 1976 N.J.A.S. survey counted only 137 adults, but as all probable locations were not surveyed, there were probably more pairs breeding than listed. The large post-breeding roosting counts of this species made in places like Stone Harbor in the 1960's could be accounted for by the proximity of large breeding populations nearby in Delaware (4,500 pairs at Pea Patch Island, in the Delaware River, Delaware, in 1976 :Buckley *et al.* 1976).

The species seems to be moving inland as a breeder north of the Delmarva Peninsula but in spite of a continuing northward range expan-

sion, it is still uncommon as a coastal breeder in New Jersey and at more northerly locations such as Long Island where it occurs in one or two colonies numbering barely a dozen pair (Buckley and Buckley unpubl. data). Paradoxically, the largest breeding concentration in New Jersey in 1976 was at the northernmost location, Shooter's Island, in Union County, which surged from 15+ pairs in 1974 to 50 pairs in 1976. Unfortunately, this location is in danger of being dismantled by the U.S. Army Corps of Engineers and being used for fill by the Corps' New York District Office. One possible explanation for the smaller numbers nesting coastally in New Jersey is the reduced number of cattle and grassy fields, the preferred feeding situation, on the coast.

The species will probably be included in our 1977 field study since it has nested on dredged material islands within the specific study area.

TABLE 10.

SPECIES: Cattle Egret

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	April					
AVERAGE	early May		8 May-18 May		late June-early July	early July
LATE						August

REFERENCES: Burger 1977a
Fowler 1958

TABLE 11.

SPECIES: Cattle Egret 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	3B	barrier is./ trees, shrubs	1 active nest, yng.		Kane 1976
Cape May Inlet	1 Jun	1B	barrier is./ trees, shrubs			Kane 1976
Cornell Harbor	3 Jun	1B	"spoil bank/ *shrubs*		1975	Kane 1976
Cowpens Is.	6 Jun	3B	"spoil bank/ shrubs	incub.	1975	Kane 1976
Gull Is. Thoro	5 Jun	17B	"spoil bank/ low shrub, Phrag			Kane 1976
Shaw Cutoff	1 Jun	9B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Shooters Is.	5 Jun	50B	island/ *Ailanthus*	incub	1975 1974	Kane 1976 Buckley & Buckley 1976
Stingaree Pt.	1 Jun	4B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	2 Jun	49B	barrier is./ trees, shrubs	*downy young*	x	Kane 1976

(continued)

TABLE 11a.

SPECIES: Cattle Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Islajo	1968		island	3-week old young (9)		Adams & Miller 1975
	1969			3-week old young (17)	x	Adams & Miller 1975
	1971			3-week old young (3)	x	Adams & Miller 1975
	1972			3-week old young (22)	x	Adams & Miller 1975
	1975	61P	"spoil is."	nested	x	Burger 1977a
Little Heron Is.	1975	24P	"spoil is."		x	Burger 1977c
Shooters Is.	1974 11 Jun	15+P	island/ trees	nested		Buckley & Buckley 1974, NJNN December 1974
Stingaree Pt.	1958	3P	small island/ Bayberry	eggs, 1 newly hatched	*	Fowler 1958, Choate 1964
	4 Jul			young		
	11 Jul			young		Fowler 1958
Stone Harbor	1958 3 May	1P	barrier is.	nest building	*	AFN October 1958
	12 July			young almost fully fledged		AFN October 1958
	1959 early July			yng. out of nest		AFN October 1959
	1960	20P				Bull 1964

* first nesting records in New Jersey

(continued)

TABLE 11a. (continued)

SPECIES: Cattle Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor	1971 10 Apr	20B	barrier is.	nesting	x	NJNN September 1971

(concluded)

E. Great Egret

Casmerodius albus

Once known as American Egret and Common Egret, the Great Egret made a remarkable comeback in the early 1900's (Allen 1957), having been almost completely exterminated during the plume trade of the 1800's only to face further disaster more recently through nesting habitat destruction and increasing pollution of its food sources. Ohlendorf et al. (1974) found that the eggs of Great Egrets in New Jersey had the highest levels of PCB's as well as the highest mean residues of DDE of any east coast locations surveyed. Today, this species, while having expanded its breeding range north to New Jersey in the 1920's and Long Island in the 1950's, seems to be having difficulties in the more southerly parts of its range (Allen 1957).

Described as breeding in considerable numbers in southern New Jersey's extensive cedar swamps around 1810 by Baird et al. (1884), Great Egret was recorded by Stone (1894) as last breeding around Townsend's Inlet in 1877. Later, Stone (1937) documents its gradual increase as a post-breeding visitor to the Cape May area during July-September of the early 1900's. Stone (1934) published a "first" nesting record of the species nesting in a Great Blue Heron colony in Marshalltown in 1934 at the request of Julian Potter but in his Bird Studies at Old Cape May published in 1937, he lists a nest record of Great Egret nesting at the same location in 1928, first observed by Turner McMullen, an egg collector. Perhaps the secrecy surrounding the 1928 nesting was a good idea. Only one year after the location was made public the birds did not nest at this site.

Nonetheless, Great Egret slowly increased as a breeding species, nesting in several locations and moving north to Sandy Hook, where there were also large numbers of Night Herons and Great Blue Herons nesting in the early 1950's. Allen (1957) points out that in spite of increasing in New Jersey in the 1940's and 1950's, by 1957 there were only 150 pairs in four or five colonies, and more recently-active sites had been deserted than were currently in use. The promising colony at Sandy Hook was de-

serted in the early 1960's, probably as a result of increasing jet aircraft disturbance (P.A. Buckley pers. comm.).

More recently, Great Egrets have nested in north Jersey at Shooter's Island in a newly discovered mixed heronry (since 1974) with Black-crowned Night Herons and Cattle Egrets (Buckley and Buckley 1974-1976).

The 1975 fixed-wing survey (Custer and Osborn 1975) recorded 954 adults at 8 locations and the 1976 N.J.A.S. survey (Kane and Farrar 1976) recorded 232 adults at 15 locations.

Stone Harbor Sanctuary seems to be the most consistently reliable place to find Great Egrets nesting in New Jersey, but they do breed regularly on the islands in the bays and inlets and will probably be investigated during the 1977 field study.

TABLE 12.

SPECIES: Great Egret

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY					mid May	late July
AVERAGE		April	early May	23-24 da.	late May-June	August
LATE		May				

REFERENCES: Adams & Miller 1975
Bent 1926
Burger 1977a
Stone 1937

TABLE 13.

SPECIES: Great Egret 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	14B	barrier is./ trees, shrubs	6 active nests, feathered young	1975	Kane 1976
Cape May Inlet	1 Jun	1B	barrier is./ trees, shrubs			Kane 1976
Cornell Harbor	3 Jun	10B	"spoil bank"/ trees, shrubs	incub., hatching, downy young	1975	Kane 1976
Cowpens Is.	4 Jun	12B	"spoil bank"	incub.	1975	Kane 1976
Flat Is.	7 Jun	4B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Gull Is. Thoro	5 Jun	13B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Little Beach Is.	5 Jun	46B	barrier is./ shrubs		x	Kane 1976
Middle Is.	6 Jun	7B	"spoil bank"/ low shrubs	downy young	1975	Kane 1976
Pork Is.	4 Jun	2B	"spoil bank"/ shrubs	incub.		Kane 1976
Shaw Cutoff	1 Jun	16B	"spoil bank"/ trees, shrubs		1975	Kane 1976

(continued)

TABLE 13. (continued)

SPECIES: Great Egret 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Shooters Is.	5 Jun	2B	island/ trees			Kane 1976
Stingaree Pt.	1 Jun	40B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	2 Jun	62B	barrier is./ trees, shrubs		x	Kane 1976
Townsend Inlet	3 Jun	1B	"spoil bank"/ shrubs			Kane 1976
Weakfish Creek	3 Jun	2B	"spoil bank"/ shrubs			Kane 1976

(concluded)

TABLE 14.

SPECIES: Great Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1972 21 Jul	1N	island/ mix col.	eggs		J. Miller 1973
Barrel Is.	1975	35P	*Iva* bushes	eggs, 1 May 1974	x	Burger 1977c
along Delaware R. (Camden vic.?)	1935 9 Jun	4P	woods	young		Stone 1937
Fish House Camden vic.	1956 3 Jul	20B	mainland	nesting		AFN October 1956
Gull Is.	1970 23 May	300B	island/ mixed col.	incub., young		NJNN September 1971
Islajo	1959		island	3-week old yng. (49)		Adams & Miller 1975
	1963			3-week old yng. (5)	x	Adams & Miller 1975
	1964			3-week old yng. (21)	x	Adams & Miller 1975
	1965			3-week old yng. (25)	x	Adams & Miller 1975
	1966			3-week old yng. (24)	x	Adams & Miller 1975
	1967			3-week old yng. (100)	x	Adams & Miller 1975
	1968			3-week old yng. (209)	x	Adams & Miller 1975
	1969			3-week old yng. (200)	x	Adams & Miller 1975
	1970			3-week old yng. (120)	x	Adams & Miller 1975
	1971			3-week old yng. (132)	x	Adams & Miller 1975
	1972			3-week old yng. (140)	x	Adams & Miller 1975
	1975	35P	"spoil is."	nested	x	Burger 1977a

(continued)

TABLE 14. (continued)

SPECIES: Great Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Island Beach	1951 17 Jun	30B	barrier is./ mixed col.	nesting		AFN October 1951
Little Beach Is.	1973	38P	barrier is./ cherry trees			Burger 1977
	1974	140P	*Iva* bushes	eggs/May 3	x	Burger 1977c
Little Heron Is.	1975	48P	"spoil is."	nested		Burger 1977a
Marshalltown Salem Co.	1928 5 May	1N	GBH col./ wet woods	incub.	*	Stone 1937, Miller 1943
	1931 9 May	1+N		incub.	x	Stone 1937
	1933 2 May	1+N		incub.	x	Stone 1937
	1934 29 Apr	10P		incub.	x	Stone 1934, 1937
	3 Jun			young		Stone 1937
	9 Aug			fledging		Stone 1937
	1935 May	10P			x	Stone 1937
New Jersey	1957	150P	4-5 col.			Allan 1957
Paulsboro Gloucester Co.	1947 9 Jul	110B	mainland/ mixed col.	nesting		AFN September 1947
Salem Salem Co.	1934	4N	mainland	bred		Cassinia 1933-1937

* first nesting record since 1877

(continued)

TABLE 14. (continued)
SPECIES: Great Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Sandy Hook	1952 14 Jun	6P	mainland	well-advanced young		AFN October 1952
	1953	12P			x	Bull 1964
	1955	22N			x	AFN October 1955
	1957	20P			x	AFN October 1957
Seven Mile Beach	1948 29 Apr	3B	barrier is.			AFN August 1948
southern New Jersey	1810	const. nos.	cedar swamps	bred mid May-Aug		Baird *et al*. 1884
Stone Harbor	1949 15 May	15B	barrier is.	nesting well under way		AFN August 1949
	1950 22 Apr	6B				AFN August 1950
	1971 10 Apr	345B		nesting		NJNN September 1971
Townsend Inlet	to 1877			bred		Stone 1894
Tuckerton vic.	1936	1P	GBH col	nested		Stone 1937

(concluded)

F. Snowy Egret

Egretta thula

Snowy Egret was fairly numerous in the 1800's along the New Jersey coast and early accounts include southern New Jersey at the northern end of its breeding range. It was regularly hunted and egged but it was the plume trade which almost extirpated it from the United States. It was extirpated as a breeder from New Jersey in the late 1880's (Burns 1929; Stone 1894). The species has made a truly remarkable recovery and today is the most abundant heron breeding in New Jersey. No longer breeding only into southern New Jersey it has also nested in northern New Jersey and is expanding its range northward and is now known in colonies as far north as Maine (P.A. Buckley pers. comm.).

In its recolonization of New Jersey, it was first found nesting at Avalon, Cape May County in 1939 (McDonald et al. 1940) not too far from its last previously recorded nest site near Ocean City in 1888 (Burns 1929). The exact location of the first modern nesting was kept secret and the birds apparently renested in 1940. They increased gradually and by the late 1950's were abundant in coastal locations such as Brigantine Refuge where they occurred regularly in large numbers during late July and August post breeding dispersal [2,000 in 1956 (AFN October 1956)].

In 1975, the fixed wing survey recorded 5372 adults at 10 locations (Custer and Osborn 1975). The 1976 N.J.A.S. survey (Kane and Farrar 1976) recorded 1091 birds at 17 locations (excluding two known heronries). Snowy Egrets are also increasing as nesters in the northern part of the state. The Shooter's Island site, discovered independently by D. Smith and F. G. Buckley and P.A. Buckley in 1974 increased to about thirty pairs of Snowy Egrets in 1976. Unfortunately this location may be dismantled and used for fill by the U.S. Army Corps of Engineers New York District.

Snowy Egret is an important species in the specific study area, outnumbered only by Glossy Ibis. As it nests on dredged material islands it will likely be one of those studied during the 1977 field season.

TABLE 15.

SPECIES: Snowy Egret

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	early April				May	
AVERAGE	mid-late April		8-26 May	18 days	June	July-August
LATE			late June-July		July	August

REFERENCES: Adams & Miller 1975
Bent 1926
Burger 1977a

TABLE 16.

SPECIES: Snowy Egret 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	22B	barrier is./ trees, shrubs	70+ active nests, feathered young	1975	Kane 1976
Black Pt.	5 Jun	3B	"spoil bank"/ Phrag			Kane 1976
Cape May Inlet	1 Jun	4B	barrier is./ shrubs, trees			Kane 1976
Cornell Harbor	3 Jun	35B	"spoil bank"/ trees, shrubs	incub.	1975	Kane 1976
Cowpens Is.	4 Jun	40B	"spoil bank"/ shrubs	incub.	1975	Kane 1976
Flat Is.	7 Jun	10B	"spoil bank"/ shrubs, Phrag	incub.	1975	Kane 1976
Gull Is. Thoro	5 Jun	86B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Little Beach S.	5 Jun	37B	barrier is./ shrubs			Kane 1976
Middle Is.	6 Jun	17B	"spoil bank"/ shrubs	downy young	1975	Kane 1976

(continued)

TABLE 16. (continued)

SPECIES: Snowy Egret 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Pork Is.	4 Jun	12B	"spoil bank"/ shrubs	incub.		Kane 1976
Shaw Cutoff	1 Jun	109B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Shooters Is.	5 Jun	30B	island/ trees	downy young	1974	Kane 1976
Stake Thoro	5 Jun	4B	"spoil bank"/ shrub			Kane 1976
Stingaree Pt.	1 Jun	171B	"spoil bank"/ trees, shrubs	downy young	1975	Kane 1976
Stone Harbor	2 Jun	493B	barrier is./ trees, shrubs	downy young	x	Kane 1976
Townsend Inlet	3 Jun	6B	"spoil bank"/ shrubs			Kane 1976
Weakfish Creek	3 Jun	12B	"spoil bank"/ shrubs			Kane 1976

(concluded)

TABLE 17.

SPECIES: Snowy Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1972 21 Jul		island mixed col.	eggs, yng. in & out of nests by 19 Aug		J. Miller 1973
Barrel Is.	1975	105P	*Iva* bushes	eggs/Apr-May	1974	Burger 1977c
Cape May	1941 8 Jun			4 fledglings		Miller 1941a
Cape May Co.	1939 9 Jul	1N	holly tree	3 well-feathered yng. (at 3 weeks old)	*	McDonald et al. 1940
	1940 30 May	1N 3B	cedar tree	1 egg	x	Worth 1941
	18 Jun			6 eggs	x	Worth 1941
	8 Jul			4 young	x	Worth 1941
Gull Is.	1970 23 May	300B	island/ mixed col.	incub., young		NJNN September 1971
Islajo	1959		island	3-week old young (10)		Adams & Miller 1975
	1963			3-week old young (28)	x	Adams & Miller 1975
	1964			3-week old young (35)	x	Adams & Miller 1975
	1965			3-week old young (28)	x	Adams & Miller 1975
	1966			3-week old young (225)	x	Adams & Miller 1975
	1967			3-week old young (209)	x	Adams & Miller 1975

* First nesting record since 1880's

(continued)

TABLE 17. (continued)

SPECIES: Snowy Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Islajo	1968		island	3-week old young (319)	x	Adams & Miller 1975
	1969			3-week old young (315)	x	Adams & Miller 1975
	1970			3-week old young (74)	x	Adams & Miller 1975
	1971			3-week old young (113)	x	Adams & Miller 1975
	1972			3-week old young (239)	x	Adams & Miller 1975
	1975	355P	"spoil is."	nested	x	Burger 1977a
Island Beach	1951 17 Jun	10B	barrier is./ mixed col.	nesting	x	AFN October 1951
Little Beach Is. (north)	1974	29P	barrier is.	nested		Burger 1977a
Little Beach Is. (northwest)	1974	6N	barrier is.	nested		Burger & Hahn 1977
	1975	2N	barrier is.	nested	x	Burger & Hahn 1977
Little Beach Is.	1973	18P	barrier is.	nested		Burger 1977c
	1974	55P	barrier is.	nested	x	Burger 1977c
Little Heron Is.	1975	200P	"spoil is."	nested		Burger & Hahn 1977
Ocean City	1872	numer.	barrier is.	nesting in cedars on beach		Stone 1937
Sandy Hook	1955	1N	mainland	raised 5 young		AFN October 1955
Seven Mile Beach	1886		barrier is.	nesting w/BCNH	x	Stone 1909

(continued)

TABLE 17. (continued)

SPECIES: Snowy Egret

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1888	1B	barrier is.	4 eggs, 1 chick/ 73 birds recently shot		Burns 1929
	1948 29 Apr	100±	in 2 col.			AFN August 1948
Shooters Is.	1974	20P	island/ trees	nested		NJNN December 1974 Buckley & Buckley 1974
Somer's Beach (Ocean City)	1812 19 May	exten- sive	barrier is./ red cedars	eggs		Wilson 1813
Stone Harbor	1947 16 Apr	100B	barrier is.			AFN July 1947
	1949 15 May	150B		nesting underway	x	AFN August 1949
	1950 22 Apr	200B			x	AFN August 1950
	1971 10 Apr	1020B		nesting	x	NJNN September 1971

(concluded)

G. Louisiana Heron

Hydranassa tricolor

The first recorded breeding of Louisiana Heron occurred as recently as 1948 when a nest was discovered at the Stone Harbor heronry (Wright 1949-1950). Before this it had been considered to be "a very rare straggler from the south" (Stone 1894), with only occasional records of it appearing in coastal New Jersey. Cruickshank (1942) cited seven records of its appearance on the south Jersey coast by 1933. By 1954 it had shown considerable increase in Cape May County (U.O.C. 1959) some 210 birds having been counted in three breeding colonies by 1958. It has regularly bred in some numbers at the Stone Harbor heronry but seems to be decreasing in recent years. They are near the northern end of their breeding range in New Jersey [only about a dozen pair nest regularly on Long Island, New York (Buckley and Buckley unpubl. obs.)] and they seem to have decreased as Snowy Egret numbers have increased, possibly from competition with them at the nesting site (P.A. Buckley pers. comm.).

The 1976 N.J.A.S. survey found 146 birds (Kane and Farrar 1976) though two known heronries were not surveyed. The 1975 fixed wing survey recorded 412 adults (Custer and Osborn 1975).

TABLE 18.

SPECIES: Louisiana Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	late March				May	
AVERAGE	late April		mid-May	21 days	early June	July-August
LATE					early July	

REFERENCES: Adams & Miller 1975
Bent 1926
Bull 1964
Burger 1977a
Wright 1949-1950

TABLE 19.

SPECIES: Louisiana Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	4B	barrier is./ trees, shrubs	feathered young	1975	Kane 1976
Cornell Harbor	3 Jun	1B	"spoil bank"/ trees, shrubs	incub., hatching, downy young	1975	Kane 1976
Cowpens Is.	4 Jun	3B	"spoil bank"/ shrubs	incub.	1975	Kane 1976
Gull Is. Thoro	5 Jun	44B	"spoil bank"/ low shrub, Phrag.		1975	Kane 1976
Shaw Cutoff	6 Jun	5B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stingaree Pt.	1 Jun	3B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	2 Jun	22B	barrier is./ trees, shrubs		x	Kane 1976
Townsend Inlet	3 Jun	3B	"spoil bank"/ shrubs			Kane 1976

TABLE 20.

SPECIES: Louisiana Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1972 21 Jul		island/ mix col.	nests, eggs, young in & out of nests on 19 Aug		J. Miller 1973
Barrel Is.	1974 Apr-May	38P	*Iva* bushes	eggs	x	Burger 1977c
Islajo	1959		island	3-week old young (7)		Adams & Miller 1975
	1963			3-week old young (16)	x	Adams & Miller 1975
	1964			3-week old young (11)	x	Adams & Miller 1975
	1965			3-week old young (9)	x	Adams & Miller 1975
	1966			3-week old young (40)	x	Adams & Miller 1975
	1967			3-week old young (45)	x	Adams & Miller 1975
	1968			3-week old young (43)	x	Adams & Miller 1975
	1969			3-week old young (71)	x	Adams & Miller 1975
	1970			3-week old young (33)	x	Adams & Miller 1975
	1971			3-week old young (25)	x	Adams & Miller 1975
	1972			3-week old young (78)	x	Adams & Miller 1975
	1975	122P	"spoil is."		x	Burger 1977a
Little Heron Is.	1975	64P	"spoil is."		x	Burger 1977a
S. New Jersey	1958	210B	3 colonies			Bull 1964

(continued)

TABLE 20. (continued)

SPECIES: Louisiana Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor	1948 12 Jun	1N	barrier is.	young (3)	*	Wright 1949-1950
	1949 4 Jun	1N 3B		young ready to climb (4)	x	Wright 1949-1950
	1971	90B	barrier is.	nesting	x	NJNN September 1971

* First nest record in New Jersey

(concluded)

H. Black-crowned Night Heron

Nycticorax nycticorax

Black-crowned Night Herons have nested in New Jersey at least since Wilson's time (1813). They were hunted and egged and destroyed by plume hunters (Stone 1909). The species nests at locations throughout the state and was second in abundance only to Green Herons in Stone's time (1937). Black-crowned Night Herons, though having been recorded at coastal locations through the 1800's, were not too well known as coastal nesters by the early 1900's, although they were recorded at a number of woodland sites in the lower Delaware Valley (Stone 1909) and listed as a "very common summer resident along streams inland but rarer on the coast" by Stone in 1894. By 1955, Fables recorded it as a local resident with "most colonies being in the southern part of the state."

The birds started to return to coastal nesting sites in some numbers during the mid-1900's but more recently their numbers have been decreasing along the coast north of Delaware Bay, probably because of habitat destruttion and human disturbance (P.A. Buckley pers. comm.). They also seem to be sensitive to environmental pollution since eggs collected in 1972 and 1973 showed a 10.6 percent decrease in shell thickness when compared to eggs that had been collected before 1947 (Clapp 1975).

Black-crowned Night Herons frequently nest in mixed species colonies as well as in colonies with only conspecifics. Their nesting habits seem variable with earlier authors referring to their nesting in tall trees of mixed deciduous woodlands as well as the coastal cedar and holly forests that were once common on the New Jersey coast. Later writers (Fables 1955, Kane and Farrar 1976) found them nesting in shrubs, low trees and more recently, in *Phragmites* beds, often low to or on the ground and frequently in company with Glossy Ibis. This variability in nest site location while of obvious adaptive value when combined with their dark colors makes colony censusing difficult. However, their crepuscular feeding habits might make a more accurate count of their numbers possible since they are usually present at the nest site during daylight hours when censusing is feasible.

Black-crowned Night Herons also have traditionally nested earlier than other species (save Great Blue Herons) often laying their eggs in April (Stone 1937) while many of the other heron species are just arriving or beginning their nest-building activities. The recent earlier arrivals of many of the other species of herons, perhaps causing nest site competition, may be another factor in their recent decline.

In 1975, the fixed wing survey (Custer and Osborn 1975) recorded 2,758 adults in 11 locations. The N.J.A.S. 1976 survey found only 611 adults in 20 locations. This is probably a low count since Kane and Farrar (1976) mention difficulty in censusing the species.

Since Black-crowned Night Herons nest on dredged material islands in the specific study area they will be given considerable attention in the 1977 field studies.

TABLE 21.

SPECIES: Black-crowned Night Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY		March	late April	22 days	May	June
AVERAGE		April	May	24 days	June	July
LATE			July	26 days	September	September

REFERENCES: Audubon Field Notes. Feb. 1964
Bent 1926
Burger 1977a
Cruickshank 1942
Miller 1939
Noble et al. 1938
Urner 1929-1930

AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3

USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)

JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166

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TABLE 22.

SPECIES: Black-crowned Night Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	37B	barrier is./ trees, shrubs		1975	Kane 1976
Brigantine Blvd.	5 Jun	14B	barrier is./ fill, shrubs, Phrag.		1975	Kane 1976
Cape May Inlet	1 Jun	50B	barrier is./ trees, shrubs	downy young		Kane 1976
Cornell Harbor	3 Jun	40B	"spoil bank"/ trees, shrubs	incub., hatching, downy young	1975	Kane 1976
Cowpens Is.	4 Jun	4B	"spoil bank"/ shrubs	incub.	1975	Kane 1976
Flat Is.	7 Jun	2B	"spoil bank"/ shrubs, Phrag.		1975	Kane 1976
Gull Is. Thoro	5 Jun	56B	"spoil bank"/ shrubs, Phrag.	downy young	1975	Kane 1976
Hammock Cove Is.	6 Jun	5B	"spoil bank"/ shrubs, Phrag.	downy young	1975	Kane 1976
Kearny	6 Jun	30B	mainland/ fresh water marsh	incub.	x	Kane 1976

(continued)

TABLE 22. (continued)

SPECIES: Black-crowned Night Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Little Beach Is. (south)	5 Jun	7B	Barrier is./ shrubs			Kane 1976
Middle Is.	6 Jun	18B	"spoil bank"/ low shrub	downy young	1975	Kane 1976
Pork Is.	6 Jun	1B	"spoil bank"/ shrubs	incub.		Kane 1976
Sandy Hook	6 Jun	6B	mainland/ trees, shrubs	1 active nest, 5 young	x	Kane 1976
Shaw Cutoff	1 Jun	7B	"spoil bank"/ trees, shrubs			Kane 1976
Shooters Is.	5 Jun	60B	island/ trees	incub.	x	Kane 1976
Stake Thoro	5 Jun	2B	"spoil bank"/ shrubs/sand			Kane 1976
Stingaree Pt.	1 Jun	8B	"spoil bank"/ trees, shrubs	downy young	1975	Kane 1976
Stone Harbor	2 Jun	257B	barrier is./ trees, shrubs	downy young	x	Kane 1976

(continued)

TABLE 22. (continued)

SPECIES: Black-crowned Night Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Townsend Inlet	3 Jun	5B	"spoil bank"/ shrubs			Kane 1976
Weakfish Creek	3 Jun	2B	"spoil bank"/ shrubs			Kane 1976

(concluded)

TABLE 23.

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1958 19 Jul	5P		nested		AFN October 1958
	1972 21 Jul		island/ mixed col.	nests, eggs, young in & out of nests by 19 August		J. Miller 1973
Avalon	1935 11 May			6 fresh eggs		Miller 1935
	1939 12 May			4 newborn young	x	Miller 1940
Barrel Is.	1975	41P	*Iva* bushes	eggs April/May	x	Burger 1977c
Brigantine	1966 6 Sep	5N	barrier is.	young		AFN February 1967
Brigantine Is.	1965 6 Sep	40B	barrier is.	young		AFN February 1966
	1967 17 Sep	11N		young		AFN February 1968
Camden vic.	1923 20 May	80N	mainland/ tall oaks	well-grown young		Stone 1937
	1930 5 May	15N	mainland/ tall oaks	eggs	x	Stone 1937
	1934 12 May	36N	mainland/ tall oaks	eggs	x	Stone 1937
	1936	50P			x	Stone 1937

(continued)

TABLE 23. (continued)

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Camden vic.	1956	200B	mainland	nesting		AFN October 1956
Cape May Co.	1940 30 May	numerous		eggs, newly hatched young		Worth 1941
	18 Jun			half-grown young		Worth 1941
	8 Jul			fledging		Worth 1941
along Delaware R. (Marshalltown?) (below Camden)	1936 9 Jun	150P	woodland/ red maple, sweet gum	young	1935	Worth 1941
Islajo	1959		island	3-week old young (93)		Adams & Miller 1975
	1963			3-week old young (26)	x	Adams & Miller 1975
	1964			3-week old young (22)	x	Adams & Miller 1975
	1965			3-week old young (18)	x	Adams & Miller 1975
	1966			3-week old young (57)	x	Adams & Miller 1975
	1967			3-week old young (104)	x	Adams & Miller 1975
	1968			3-week old young (206)	x	Adams & Miller 1975
	1969			3-week old young (184)	x	Adams & Miller 1975
	1970			3-week old young (55)	x	Adams & Miller 1975
	1971			3-week old young (107)	x	Adams & Miller 1975
	1972			3-week old young (155)	x	Adams & Miller 1975
	1975		"spoil Is."		x	Burger 1977a
Island Beach	1941 3 May			4 fledglings		Miller 1941a

(continued)

TABLE 23. (continued)

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Island Beach	1951 17 Jun	40B	barrier is.	nesting		AFN October 1951
Kearny	1974 5 May	50P	Hackensack Meadows	7 nests with young	x	NJNN September 1974, Kane 1974
Little Beach Is.	1974	55P	barrier is.	nested		Burger 1977a
	1975	28P		nested	x	Burger 1977c
Little Beach Is. (north)	1974	38P	barrier is.	nested		Burger 1977c
Little Beach Is. (northwest)	1974	22N	barrier is.	nested		Burger & Hahn 1977
	1975	21N		nested	x	Burger & Hahn 1977
Little Heron Is.	1975	80P	"spoil island"	nested		Burger 1977a
Merchantville Camden Co.	1928 5 May	50+N	mainland	eggs		Miller 1928a
	1929 21-25 Apr			"highly incubated eggs"	x	Miller 1930
Paulsboro Gloucester Co.	1938 12 Jun		mainland	fledglings		Miller 1939
	1947	100B	mainland/ mixed col.		x	AFN September 1947

(continued)

TABLE 23. (continued)

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Peermont (Seven Mile Beach)	1915 30 May			4 fresh eggs		Miller 1918
Sandy Hook	1942	50P	mainland			Cruickshank 1942
	1955	incr.			x	AFN October 1955
	1957	700P			x	AFN October 1955
Seven Mile Beach	1888	12P	barrier is./		x	Burns 1929
	1890	unc.	cedars		x	Shick 1890
	1915 30 May		barrier is./ cedars, holly			Stone 1937
	1916 4 Jun	7N		eggs		Stone 1937
	1918 16 Jun	4N		eggs		Stone 1937
	1920 31 May	3N				
	1921 12 Jun	3N		eggs		Stone 1937
	1922 21 May	1N		eggs, well-grown young		Stone 1937
	1924 4 Jul	many		eggs, young to 3/4 grown		Stone 1937
	1934 12 May	36N		eggs		Stone 1937

(continued)

TABLE 23. (continued)

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1948 29 Apr	6B	2 col.			AFN August 1948
Seven Mile Beach vic.	1926 13 Jun		salt meadows/ red cedar	eggs, young		Stone 1937
	27 Jun			fledging	x	Stone 1937
	1927 3 Jul		salt meadows/ red cedar	young, fledglings	x	Stone 1937
	1928 15 May			nests	x	Stone 1937
Shooters Is.	1974 June	20P	island/ trees	nested		NJNN December 1974
	1975 June	50P		nested	x	Buckley & Buckley 1975
Somer's Beach (Ocean City)	1812 19 May		barrier is./ cedars	eggs		Wilson 1813
Stone Harbor	1924 4 Jul		barrier is.	3 fresh eggs		Miller 1924
	1947 16 Apr	100+B		nesting		AFN July 1947
	1948 15 May	100+B		nesting well underway	x	AFN August 1949

(continued)

TABLE 23. (continued)

SPECIES: Black-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Woodcliffe L. Bergen Co.	1951 17 Jun	40B	mainland	nested		AFN October 1951

(concluded)

I. Yellow-crowned Night Heron

Nyctanassa violacea

Yellow-crowned Night Herons have never been abundant in the New Jersey area. Until the first recorded nest was found in a Black-crowned Night Heron rookery at Seven Mile Beach (Stone 1937) by Benjamin Doak and Charles Hiatt on June 6, 1927, it was not previously regarded as a breeding bird in New Jersey though Stone (1937) suspected that it had been overlooked previously. They usually occur in small breeding colonies and are often associated with Black-crowned Night Herons.

Stone (1894) listed it as a "very rare southern straggler" and Bent (1926) records it as casual in New Jersey and breeding only as far north as South Carolina. Griscom (1923) records it as a casual visitor and Cruickshank (1942) listed it as an uncommon regular summer visitor in coastal marshes and cites the collection of a few young near Rutherford, N.J. around 1900 for the Bronx Zoo. Fables (1955) listed it as a rare breeder in the southern part of the state. Bull (1964) listed it as local and uncommon.

The bird increased in New Jersey during the late 1920's and 1930's and has been recorded with some regularity roosting if not breeding at the Stone Harbor Heronry in the 1950's - 1970's. The 1976 N.J. Audubon Society Survey (Kane & Farrar 1976) recorded 43 birds but the 1975 fixed wing survey recorded 130 adults (Custer & Osborn 1975). This area is at the northern edge of the species' breeding range and despite breeding range extensions into New England (e.g. Mass. in 1976) it appears to be declining (P.A. Buckley pers. comm.).

Yellow-crowned Night Herons were not decimated by the plumage trade but were once regarded as game birds and were hunted and eaten with regularity especially in the southern U.S.

TABLE 24.

SPECIES: Yellow-crowned Night Heron

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY			late April		May	late May
AVERAGE	mid April		June		June	July-August
LATE			July		July	September

REFERENCES: Burger 1977
Cassinia 1939
Stone 1937

TABLE 25.

SPECIES: Yellow-crowned Night Heron 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine Blvd.	4 Jun	2B	barrier is./ fill, shrubs, Phrag.			Kane 1976
Cape May Inlet	1 Jun	4B	barrier is./ trees, shrubs			Kane 1976
Cornell Harbor	3 Jun	2B	"spoil bank"/ trees, shrubs	incub., hatching, downy young	1975	Kane 1976
Cowpens Is.	4 Jun	1B	"spoil bank"/ trees, shrubs	incub.	1975	Kane 1976
Gull Is. Thoro	5 Jun	13B	"spoil bank"/ low shrubs, Phrag.		1975	Kane 1976
Pork Is.	4 Jun	2B	"spoil bank"/ shrubs	incub.		Kane 1976
Shaw Cutoff	1 Jun	3B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stingaree Pt.	1 Jun	5B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stone Harbor	2 Jun	11B	barrier is./ trees, shrubs		x	Kane 1976

TABLE 26.

SPECIES: Yellow-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon vic.	1936			breeding	x	Stone 1937
Absecon Bay	1973 Jul-Sep	6N	50-ft. pines			NJNN December 1973
Avalon	1948 25 Jul	2N		fledging		AFN October 1948
	1949 3 Jul	2N		eggs, young	x	AFN October 1949
Brigantine Is.	1965 6 Sep	12B	barrier is.	young		AFN February 1966
	1967 26 Apr			eggs	x	AFN August 1967
	16 May	7N		eggs	x	AFN August 1976
Brigantine N.W.R.	1967	small				Burger 1977
Burlington Co.	1949	1N	mainland	eggs		AFN October 1949
Gloucester Co.	1950 25 May	1N	mainland/ pin oak	well-grown young		AFN October 1950
	1952	2P		raised young		AFN October 1952
Island Beach	1951 17 Jun	10B	barrier is./ mixed col.	nesting		AFN October 1951

(continued)

TABLE 26. (continued)

SPECIES: Yellow-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Kearny	1975	2B	mainland			NJNN November 1975
Little Beach Is.	1974	10P	barrier is.			Burger 1977
Salem Co.	1939 30 Apr	1N	mainland	eggs		Cassinia 1939
Seven Mile Beach	1926 13 Jun	1P	cedar grove/ BCNH rookery			Stone 1937
	31 Jul	4B		1 fledged young		Stone 1937
	1927 6 Jun	2N	cedar grove/ BCNH rookery	eggs	*	Stone 1937
	12 Jun			eggs, young	x	Stone 1937
	26 Jun			1 young w/pinfeathers	x	Stone 1937
	24 Jul			young ready to fledge	x	Stone 1937
	1930 3 Jun	2B			x	Stone 1937
	1935	3B			x	Stone 1937
	28 Jul				x	Stone 1937
	1948 29 Apr	5B				AFN August 1948
	1947 16 Apr	12B		nesting		AFN July 1947
Stone Harbor	1950	inc.	barrier is.	nesting		AFN October 1950
	1966	26B			x	NJNN December 1966
	1971	5B		nesting	x	NJNN September 1971
	1972 Jun	sev. P.		nesting	x	NJNN September 1972

* First recorded nest in New Jersey

(continued)

TABLE 26. (continued)

SPECIES: Yellow-crowned Night Heron

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor	1973 Jun	sev. P.		nesting	x	NJNN September 1973
Westville	1955 1 May	1P	mainland	nest building		AFN October 1955

(concluded)

J. Glossy Ibis

Plegadis falcinellus

Glossy Ibis is an Old World species that has invaded North America with great success. In 1976 it was the most numerous of the colonially nesting wading birds in New Jersey (Kane & Farrar 1976). The species was first recorded at Great Egg Harbor in 1817 on May 7 when it was shot by a Mr. Oram (Stone 1937): this specimen was used in the first description of Glossy Ibis in North America by George Ord (Baird et al. (1884). The early ornithologists were unfamiliar with it previously and it was regarded as a curiosity by those seeing it at Egg Harbor. Additional specimens were taken in May 1917, one in Baltimore and two in the District of Columbia (Stone 1937). Stone (1894) describes it as a "very rare straggler" referring to one specimen collected by John Krider in 1866. The next recorded appearance in New Jersey was again in May at the Metedeconk River, north of Barnegat, and was seen by Charles Urner (1932) in 1932. Cruickshank (1942) noted a number of N.J. records in the 1930's as far north as Troy Meadows, Passaic County. Fables (1955) recorded it as becoming increasingly regular in the late 1940's and early 1950's, culminating in the first recorded nesting in 1955 in Cape May County on July 4 (U.O.C. 1959); by 1957 it had nested in Atlantic County as well. By 1958, 122 birds were recorded roosting at Stone Harbor Sanctuary in August.

In recent years, the population has literally exploded in New Jersey and in 1975 the fixed wing survey (Custer and Osborn 1975) recorded 3878 adults. The 1976 N.J.A.S. survey recorded 2515 adults (Kane and Farrar 1976) and noted that it was the most numerous of the wading bird species.

Glossy Ibis seems to be not only expanding its breeding range (by breeding in New Jersey it jumped from North Carolina and then radiated north and south from New Jersey), but also increasing in numbers (P.A. Buckley pers. comm.). It is frequently found nesting low in *Phragmites communis*, another European invader of the New World, a habit which will insure it no lack of nesting sites. In addition to this, Glossy Ibis now

also seems to be returning to New Jersey in early March whereas most of the early records showed this species to arrive in May, possibly giving it a competitive edge in early nest site occupancy.

It is frequently found nesting on dredged material islands in New Jersey and should be an important species in the 1977 field studies.

TABLE 27.

SPECIES: Glossy Ibis

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY			late April		late May	
AVERAGE		April	6-22 May	21 days	June-July	early-late July
LATE		May	June			August-early Sept.

REFERENCES: Adams & Miller 1975
Bent 1926
Burger 1977a
Ulmer 1955-1957

TABLE 28.

SPECIES: Glossy Ibis 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat	8 Jun	78B	barrier is./ trees, shrubs			Kane 1976
Black Pt.	5 Jun	98B	"spoil bank"/ Phrag			Kane 1976
Brigantine Blvd.	5 Jun	6B	barrier is./ fill, shrubs, Phrag			Kane 1976
Cape May Inlet	1 Jun	100B	barrier is./ trees, shrubs	incub., downy yng.		Kane 1976
Cornell Harbor	3 Jun	20B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Cowpens Is.	4 Jun	40B	"spoil bank"/ shrubs	incub.	1975	Kane 1976
Flat Is.	7 Jun	13B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Gull Is. Thoro	5 Jun	420B	"spoil bank"/ lo shrub, Phrag	downy yng.	1975	Kane 1976
Little Beach Is.	5 Jun	5B	barrier beach/ shrubs			Kane 1976

(continued)

TABLE 28. (continued)

SPECIES: Glossy Ibis 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Middle Is.	6 Jun	73B	"spoil bank"/ lo shrub	downy young	1975	Kane 1976
Shaw Cutoff	1 Jun	670B	"spoil bank"/ trees, shrubs		1975	Kane 1976
Stake Thoro	5 Jun	2B	"spoil bank"/ lo shrub, sand			Kane 1976
Stingaree Pt.	1 Jun	274B	"spoil bank"/ trees, shrubs	incub.	1975	Kane 1976
Stone Harbor	2 Jun	705B	barrier is./ trees, shrubs	incub.	x	Kane 1976
Townsend Inlet	3 Jun	3B	"spoil bank"/ shrubs			Kane 1976
Weakfish Creek	3 Jun	8B	"spoil bank"/ shrubs			Kane 1976

(concluded)

TABLE 29.

SPECIES: Glossy Ibis

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1958 July	5P		nesting		AFN Oct. 1958
	1972 21 Jul	most comm.	island/ mixed col.	nest, eggs, yng in & out of nests 19 Aug		J. Miller 1973
Atlantic Co.	1957 Jul	12P	3 col.	nesting		U.O.C. 1959
Barrel Is.	1975	70P	*Iva* bushes	eggs in Apr/May		Burger 1977c
Brigantine NWR	1957	3-5P		nested		Rogers 1961
Cape May Co.	1955 17 May	1B		nest bldg.	*	AFN Oct. 1955, Ulmer 1955-1957
	3 Jul	1N		3 eggs	*	Ulmer 1955-1957
	4 Jul			2 hatched	*	Ulmer 1955-1957
	31 Jul	1N		another nest w/3 yng about to fledge	*	Ulmer 1955-1957
	1956 16 Jun	1N		3 yng. out of nest	x	AFN Oct. 1956
	28 Jun	1N		6 pipped eggs	x	AFN Oct. 1956
	1956 5 Jul	3N		yng.		Aud. Newsl. Nov. 1956
Gull Is.	1970 23 May	300B	island/ mixed col.	incub., yng.		NJNN Sept. 1970

*first nesting record in New Jersey

(continued)

TABLE 29. (continued)

SPECIES: Glossy Ibis

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Islajo	1963		island	3 wk old yng. (1)		Adams & Miller 1975
	1964			3 wk old yng. (15)	x	Adams & Miller 1975
	1965			3 wk old yng. (12)	x	Adams & Miller 1975
	1966			3 wk old yng. (31)	x	Adams & Miller 1975
	1967			3 wk old yng. (57)	x	Adams & Miller 1975
	1968			3 wk old yng. (61)	x	Adams & Miller 1975
	1969			3 wk old yng. (102)	x	Adams & Miller 1975
	1970			3 wk old yng. (11)	x	Adams & Miller 1975
	1971			3 wk old yng. (99)	x	Adams & Miller 1975
	1972			3 wk old yng. (199)	x	Adams & Miller 1975
	1975	331P	"spoil island"	nested	x	Burger 1977a
Little Beach Is.	1975	6N	barrier island	nested		Burger & Hahn 1977
Little Heron Is.	1975	44P	"spoil island"			Burger 1977a
Stone Harbor	1955		barrier is.	(see Cape May Co.)		Rogers 1961
	1960	15P			x	Rogers 1961
	1964	175B		nesting	x	Crawford 1964
	1971 10 Apr	941B		nesting	x	NJNN Sept. 1971

(concluded)

K. Great Black-backed Gull

Larus marinus

Great Black-backed Gull is the most recent (1966) colonial nester to be added to the list of breeding species in New Jersey (J. Miller 1966). It had occurred regularly prior to 1966, first as a "rare winter visitor along the coast" (Stone 1894), then as a "rather rare but regular winter visitant" (Stone 1909) and by 1937 Stone described it as occurring regularly in small numbers during the winter months. In 1942, Cruickshank described it as "increasingly common in winter" and Fables (1955) listed it as now having been observed "every month of the year" and mentions a marked increase in its numbers during the late 1930's and 1940's.

Nisbet (1971) discusses the rapid increase of this species in the Northeast and points out that its numbers of breeding pairs had been doubling every 9-10 years. The species was probably breeding in nearby Long Island, New York as early as 1940 but no actual nest was found until 1944 when Wilcox (1944) banded a young bird on Cartwright Island in Gardiner's Bay. The species moved southwest as a nester and was found nesting by P.A. Buckley at Canarsie Pol in Jamaica Bay in 1960, then its southernmost nesting location. By 1970 eight pairs were found nesting in New Jersey and in 1976 Burger (pers. comm.) recorded 14 nests in Ocean County alone, while the New Jersey Audubon Society survey recorded 85 adults at 9 locations (Kane and Farrar 1976).

There is limited habitat available for the species since it requires dryer locations than the other gulls nesting in N.J. (Burger pers. comm.) but it probably can out-compete Herring Gulls for these sites.

Since the highest and dryest locations in the specific study area are on dredged material islands there is a good possibility that this species will be present at least in limited numbers at some of the study sites.

TABLE 30.

SPECIES: Great Black-backed Gull

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	mid March		early April		early May	June
AVERAGE	late March		7-18 April	26 da.	May	late June-early July
LATE			early May		late May	mid July

REFERENCES: Bent 1921
Burger pers. comm.

TABLE 31.

SPECIES: Great Black-backed Gull 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Big Fish Thoro	5 Jun	16B	"spoil bank"		x	Kane 1976
Carvel Is. (W)	1976	2N	in *Iva* bushes	nested		Burger pers. comm
Clam Is.	8 Jun	25B	"spoil bank"/ grass, sand, "spoil"		1975	Kane 1976
Clam Is. (NE)	1976	2N	in *Iva* bushes	nested	x	Burger pers. comm.
Clam Is. (NW)	1976	2N	in *Iva* bushes	nested	x	Burger pers. comm.
Clam Is. (SE)	1976	2N	in *Iva* bushes	nested	x	Burger pers. comm.
Clam Is. (SW)	1976	1N	in *Iva* bushes	nested	x	Burger pers. comm.
Egg Is.	1976	2N	in *Iva* bushes	nested		Burger pers. comm.
Great Flat	2 Jun	8B	salt marsh/dredge			Kane 1976
Gull Is. Thoro	5 Jun	11B	"spoil bank"		1975	Kane 1976
Middle Is.	6 Jun	10B	"spoil bank"/ grass, sand	downy young	x	Kane 1976
Nummy's Is.	2 Jun	8B	"spoil bank"/dredge		x	Kane 1976
Sandy Is.	1976	1N	in *Iva* bushes	nested		Burger pers. comm.
Sloop Is.	1976	2N	in *Iva* bushes	nested		Burger pers. comm.

TABLE 32.

SPECIES: Great Black-backed Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay	1966 6 Jul	2N	two islands/ Bayberry, salt marsh grass	3 young	*	J. Miller 1966
	1970	8P		nested	x	AFN October 1970
Clam Is.	1975	8P	island/ *Iva* bushes	nested	x	Burger pers. comm.

* first recorded nesting in New Jersey

L. Herring Gull

Larus argentatus

Herring Gulls have long been present in New Jersey although mainly as an abundant winter resident (Stone 1894) until 1946 when the first nest was found by Turner McMullen (1947) at Stone Harbor.

Stone (1937) described it as the most abundant winter gull and as present in varying numbers each month of the year, but most numerous from September through April. Small numbers summered along the beaches in southern New Jersey and Stone describes one small group eating Common Tern eggs and chicks that had been washed out behind Five Mile Beach in 1931.

One obscure record of Herring Gull eggs supposedly found on Gull Island near Sea Isle City exists in U.S. National Museum records from a brief publication by Charles Shick in The Oologist in 1898. This record has not been referred to anywhere else in the literature to the best of my knowledge, and while it is not impossible for Herring Gulls to have nested in New Jersey prior to 1946, probably as a solitary or extraordinary occurrence (it was then not known as a breeder south of Maine) this reference has been ignored by knowledgeable authors writing about these birds in New Jersey. Shick was an egg collector and if this was indeed an isolated nesting of the species at that time the birds did not nest again as far as we know until 1946, possibly because of Shick's collecting activities. The record is included here in the interests of historical perspective.

Fables (1955) also recorded Herring Gull as being present every month of the year and as a breeding species. Until 1964, however, it was found breeding at scattered locations, in single pairs or only a few pairs. In 1964, two substantial colonies were found: one, of 30 pairs in the vicinity of Absecon Inlet, and at Clam Island in Barnegat Bay, 50 pairs were found (AFN Oct. 1964; Rogers 1964). Since then, Herring Gull colonies have increased in size with the 1976 Clam Island colony with 800 pairs being one of the largest (Burger pers. comm.).

As the breeding population of Herring Gulls in New Jersey has increased, the limited availability of higher, dry elevations in the marsh has caused some competition for nest sites with Laughing Gulls (Burger 1977d) and with Common Terns (Burger and Shisler 1976). Burger (1977d) found that the Herring Gulls are now moving into the salt marsh and nesting on *Spartina* mats when higher ground is not available to them. This places them in competition with Laughing Gulls and with the Common Terns forced off the beaches into the marshes because of disturbance to their more typical barrier beach nesting locations (Burger and Shisler 1976; F. G. Buckley and P. A. Buckley pers. obs.). Nest site competition among these species does not bode well for either the Terns or the Laughing Gulls, because the earlier arriving, more aggressive and larger Herring Gulls will probably be the winners (Drury 1965; Nisbet 1973).

Since Herring Gulls nest around the periphery of dredged material islands in the specific study area they will most likely be a part of the 1977 field study.

TABLE 33.

SPECIES: Herring Gull

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	late March		early April	21-23 days	early May	mid June
AVERAGE	early April		mid April-early May	29-32 days	late May-early June	late June-early July
LATE	late April		late May	32 days	July	late July-early August

REFERENCES: Burger 1977d
Burger pers. comm.
J. Miller 1966a
Segré *et al.* 1968

TABLE 34.

SPECIES: Herring Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Big Fish Thoro	5 Jun	145B	"spoil bank"/ sand	downy young	x	Kane 1976
Carvel Is. (W)		108P	island	nested		Burger & Lesser 1976
Clam Is.	8 Jun	800+B	"spoil bank"/ grass, sand, "spoil"		1975	Kane 1976
	1976	800P	salt marsh		x	Burger 1977b
Clam Is. (NE)	1976	284N	salt marsh grass, *Iva* bushes		x	Burger pers. comm.
Clam Is. (NW)	1976	185N	salt marsh grass, *Iva* bushes		x	Burger pers. comm.
Clam Is. (SE)	1976	196N	salt marsh grass, *Iva* bushes		x	Burger pers. comm.
Clam Is. (SW)	1976	25N	salt marsh grass, *Iva* bushes		x	Burger pers. comm.
Egg Is.	1976	15N	salt marsh grass, *Iva* bushes		x	Burger pers. comm.
Goosebar Sedge	6 Jun	36B	"spoil bank"/ "spoil"	downy young	x	Kane-1976

(continued)

TABLE 34 (continued)

SPECIES: Herring Gull 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Great Flat	2 Jun	150B	salt marsh/ dredge		1975	Kane 1976
Gull Is. Thoro	5 Jun	130B	"spoil bank"/ shrubs, Phrag		1975	Kane 1976
Ham Is.	1976		island			Burger & Lesser 1976
Hammock Cove Is.	6 Jun	42B	"spoil bank"/ low shrub, grass, sand	downy young	1975	Kane 1976
Hospitality Creek	4 Jun	50B	"spoil bank"/ sand, herb, vegetation	downy young		Kane 1976
Middle Is.	6 Jun	2500B	"spoil bank"/ sand, grass	downy young	x	Kane 1976
Nummy's Is.	2 Jun	512B	"spoil bank"/ sand, dredge	downy young		Kane 1976
Sandy Hook	7 Jul	40B	mainland beach/ shrubs, grass	eggs, chicks		Kane 1976
Sandy Is.	1976	56N	"spoil is."/ low bushes, grass	nested	x	Burger & Shisler 1976

(continued)

TABLE 34 (continued)

SPECIES: Herring Gull 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Sloop Is. (E)	1976	50N	island	nested		Burger pers. comm.
Sloop Is. (W)	1976	75N	island	nested		Burger pers. comm.
Somers Bay	4 Jun	10B	"spoil bank"/ sand	downy young, probably	1975	
Somers Bay	9 Jun	10B		incub.	x	Kane 1976

(concluded)

TABLE 35

SPECIES: Herring Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Bay vic.	1966 6 Jul		3 islands	125 young banded		NJNN December 1966
Absecon Inlet vic.	1964	30P				AFN October 1964
Barnegat Bay vic.	1964	50P				AFN October 1964
Big Heron Is.	1974	58P	"spoil is."/ Phrag *Spartina*	nested		Burger 1977d
Brigantine N.W.R.	1966 27 May			eggs		Segré et al. 1966
	20 Jun			nests, eggs		Segré et al. 1968
Cape May	1949 12 Jun	1N		eggs	x	AFN October 1949
	1949 15 Jun	1N		eggs		AFN October 1949
Clam Is.	1964 22 Jul	50P		downy young, fledging	x	Rogers 1964
Egg Is.	1971-1976	20P		nested		Burger 1977d

(continued)

TABLE 35 (continued)

SPECIES: Herring Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Egg Is.	1975	20P	*Spartina*	nested	x	Burger pers. comm.
Elder Is.	1971-1976	15-30P		nested		Burger 1977d
	1975	20-30P			x	Burger pers. comm.
Gull Is. (nr. Sea Isle City)	1883 June			eggs		U.S. Natl. Mus. Rec.*
Gull Is.	1970 17-23 May	25N				NJNN September 1970
Islajo	1973-1974	120N	"spoil is."/ sand dunes	nested, eggs 15 May		Burger 1977d
Little Beach Is.	1973	15P	barrier is.			Burger pers. comm.
	1974 18 Mar	30P	*Iva* bushes	nests, eggs in April	x	Burger pers. comm.
Little Gull Is.	1975	20P				Burger pers. comm.
Long Beach Is.	1947	2N	barrier is./ marshes			Fables 1955
Ring Is.	1965 1 Jun	17N	island/ *Iva*, fill			Bongiorno & Swinebroad 1969

* see text for discussion

(continued)

TABLE 35 (continued)

SPECIES: Herring Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Ring Is.	1966	42N		young	x	Bongiorno & Swinebroad 1969
Sandy Is.	1971	50P	"spoil is."/ salt marsh, bushes	nested	x	Burger & Shisler 1976
	1972		"spoil is."/ "spoil", grass, bushes	nested	x	Burger & Shisler 1976
Sloop Is. (E)	1971	1N	marsh is.	nested		Burger pers. comm.
	1973	10N		nested	x	Burger pers. comm.
	1975	25N		nested	x	Burger pers. comm.
Sloop Is. (W)	1975	50N	marsh is.	nested		Burger pers. comm.
Stone Harbor	1946 14 Jul	1N	barrier is.	eggs	*	McMullen 1947
	1947 Jul	1N			x	Cassinia 1947-1948
	1952 21 May	1N		eggs	x	AFN October 1952
	1955 21 May	1N	in LG col.	eggs	x	AFN October 1955

* first nesting record in New Jersey

(continued)

TABLE 35 (continued)

SPECIES: Herring Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor vic.	1966 13 Jul	45N	small bay island	eggs, young		J. Miller 1966a
Tuckerton	1974 9 Jun	6N		hatching		Clapp 1975

(concluded)

M. Laughing Gull
Larus atricilla

Laughing Gulls have always been abundant breeders in New Jersey except for a brief period in the late 1800's and early 1900's when the millinery trade caused a drastic reduction in their numbers. Accounts of their breeding in the salt meadows behind the barrier beach islands in New Jersey in the 1800's described it as abundant (Burns 1929) but by 1894, Stone called it a "summer resident on the coast, formerly abundant"; and by 1909, he found it in only two colonies, one on Gull Island and one on Brigantine Island. By the 1930's the species was again increasing as a breeder in New Jersey and was listed as "common" by McMullen (1938).

In spite of their apparently healthy and increasing population in New Jersey, the species may be in trouble in the Northeast (Clapp 1975). It has failed to return to New York as a breeder in spite of once nesting abundantly on Long Island (Giraud 1844; Cruickshank 1942) probably because of extensive drainage and ditching of the salt marshes and the presence of increasing populations of Herring and Great Black-backed Gulls at just about the time Laughing Gulls were increasing in New Jersey (1930's-1950's) and should have been reaching Long Island. In New Jersey, Laughing Gulls, though facing reduced salt marsh area also because of dredging, draining and ditching activities, still managed to increase in the New Jersey salt meadows. Fables (1955) listed them as breeding "locally but abundantly" in the southern coastal counties. They are, however, still not known to breed above Clam Island in Barnegat Bay, probably because of the greater development and pollution encountered in northern portions of the state where apparently suitable habitat does still exist.

The 1976 N.J.A.S. survey (Kane and Farrar 1976) counted 15,375 Laughing Gulls at eighteen locations but since these are strictly marsh nesters in New Jersey, it is probable that some colonies were overlooked since this was a ground survey rather than an aerial survey. In 1964 the population of Cape May County alone was estimated at 15,000 birds

(Crawford 1964).

If, as data gathered from Burger (1977d; pers. comm.) indicates, competition for nesting sites between Laughing Gulls and Herring Gulls becomes a regular occurrence, the future does not look too promising for New Jersey Laughing Gulls. The recent range expansion of Great Black-backed Gulls is yet another problem that the Laughing Gulls will have to face.

Laughing Gulls nest in salt marshes adjacent to/or on dredged material island and will be a consideration in the 1977 field season.

TABLE 36.

SPECIES: Laughing Gull

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	mid April		early May		early June	June
AVERAGE	late April		mid-late May	20 days	mid June	July-August
LATE	early May		mid-late June		early July	September

REFERENCES: Bent 1921
Bongiorno 1970
Burger 1975
Burger 1976
Burger 1977d
Burger pers. comm.
Frohling 1966

TABLE 37.

SPECIES: Laughing Gull 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST DUE	REFERENCE
Anglesea Is.	3 Jun	80B	marsh is./ salt marsh	incub.		Kane 1976
Brigantine Channel E.	8 Jun	160B	marsh is./ salt marsh	incub.	1975	Kane 1976
Brigantine Channel W.	5 Jun	80B	marsh is./ salt marsh	incub.	1975	Kane 1976
Burrough's Hole	3 Jun	10B	salt marsh	incub.		Kane 1976
Clam Is.	8 Jun	40+B	"spoil bank"/ salt marsh	egg laying, incub.	x	Kane 1976
	April-Jul	5000P	"spoil is."/ salt marsh	nested	x	Burger 1977c
Great Flat	2 Jun	5000B	salt marsh	incub.		Kane 1976
Great Thorofare	6 Jun	1695B	marsh is./ salt marsh	incub.	x	Kane 1976
Hospitality Creek	4 Jun	19B	"spoil bank"/ adj. marsh	incub.		Kane 1976
Middle Sedge	6 Jun	6B	marsh is./ salt marsh	incub.	x	Kane 1976

(continued)

TABLE 37 (continued)

SPECIES: Laughing Gull 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE	PAST USE	REFERENCE
Muddy Hole	2 Jun	3755B	Salt marsh	incub.		Kane 1976
Nummy's Is.	2 Jun	650B	"spoil bank"/ salt marsh	incub.		Kane 1976
Pork Is.	4 Jun	10B	marsh is./ salt marsh	incub.		Kane 1976
Ring Is.	2 Jun	3000+B	salt marsh	incub.	x	Kane 1976
Somers Bay	4 Jun	50B	"spoil bank"/ adj. marsh	incub.	1975	Kane 1976
South Clam Bar	8 Jun	426B	salt marsh is.	incub.	1975	Kane 1976
Strathmere Bay	3 Jun	10B	"spoil bank"/ adj. marsh	pairing, territory formation	x	Kane 1976
Whirlpool Is.	4 Jun	310B	marsh is./ salt marsh	incub.	1975	Kane 1976

(concluded)

TABLE 38.

SPECIES: Laughing Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine	1911			eggs		U.S. Natl. Mus. Coll.
Brigantine Is.	1908-1909		one of 2 colonies		x	Stone 1909
Brigantine N.W.R.	1973 May-Jun		*Spartina* mats	nested	x	Burger 1977c
Cape May Co.	1964	15000B	marshes		x	Crawford 1964
Clam Is.	1975 10 Apr-25 Jul	5000P	island/ *S. alternif-lora*	nested	x	Burger pers. comm.
Egg Is.	1923 16-17 Aug			nests, eggs, young		Hilliard 1923
	1927 31 May	629N		eggs	x	Hilliard 1927
	1959 19 Jun			hatching	x	AFN October 1959
Fishing Creek (Cape May Co.)	1813 mid May	immense nos.				Wilson 1814

(continued)

TABLE 38 (continued)

SPECIES: Laughing Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Great Egg Harbor	1829	common				Audubon 1844
Gull Is.	1882-1890 May-Jun	vast		eggs	x	Shick 1890
	1908-1909		one of two colonies		x	Stone 1909
Little Beach Is.	1921 18 Jul	300B		eggs, young	1892	Stone 1937
	1962 23 Sep		barrier is./ salt marsh	young	x	Frohling 1966
	1974 14 Jun 20 Jul	4000P	barrier is./ *S. alternif-lora*	nested	x	Burger pers. comm.
	1975	5000-7000P			x	Burger pers. comm.
Long Point Is.	1975	2000P	*Spartina* marshes	nested	x	Burger pers. comm.
Ring Is.	1964 11 Jun-	765N	marsh is./ salt marsh	nested		Bongiorno 1970

(continued)

TABLE 38 (continued)

SPECIES: Laughing Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Ring Is.	5 Aug.			nested	x	Bongiorno 1970
	1965 2 Apr- 18 Aug	841N		nested	x	Bongiorno 1970
	1966 31 Mar- 23 Jul	378N		nested	x	Bongiorno 1970
	1967 30 May- 29 Jun	390N	marsh is./ salt marsh	nested	x	Bongiorno 1970
Seven Mile Beach vic.	1919 18 May		marshes	eggs		Stone 1937
	1920 4 Jul	14N		eggs	x	Stone 1937
	1921 7 Jun	51N		eggs	x	Stone 1937
	1922 18 Jun	38N		eggs	x	Stone 1937
	1923 13 Jul			eggs	x	Stone 1937

(continued)

TABLE 38 (continued)

SPECIES: Laughing Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach vic.	1925 21 Jun	14N			x	Stone 1937
	1926 20 Jun	236N		eggs, young	x	Stone 1937
	1927 19 Jun	51+N		eggs, downy young	x	Stone 1937
	1928 9 Jun	181N		eggs, young	x	Stone 1937
	1931 6 Jun	41N		eggs	x	Stone 1937
	1932 20 Jun	680N		eggs, young	x	Stone 1937
Stone Harbor	1899 June	colony	salt meadows	eggs		Burns 1929
	1908 16 Jun			eggs		U.S. Natl. Mus. Coll.
	1925 21 Jun			"highly incub. eggs"	x	Miller 1925
	1927 19 Jun	50+N		eggs, chicks	x	Miller 1928

(continued)

TABLE 38 (continued)

SPECIES: Laughing Gull

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor	1929 4 Jul	120N		eggs		Miller 1930
	1930 15 Jun			nests	x	Miller 1931
	1931 19 Jul			eggs	x	Miller 1932
	1938 May-Jun	500+B	barrier is.	nested	x	Noble & Lehrman 1940
	1948 25 Jul	3000B		fledging	x	AFN October 1948
Stone Harbor vic.	1937 11 Jul			young	x	Buckalew 1938

(concluded)

N. Gull-billed Tern

Gelochelidon nilotica

Gull-billed Terns were breeding in New Jersey in Wilson's time, for he describes them (1813) from Cape May, feeding over the salt marshes in May, catching "black spiders" and also nesting in the salt marshes on "drift grass". The species was also listed as breeding in New Jersey by Baird et al. (1884) and Audubon found it "present" at Great Egg Harbor in 1829 during May and June (Burns 1929).

Stone (1894) listed it as a "former breeder last known to have nested in 1886." Shick, writing in 1890, described it as a rather common visitor and breeder at Seven Mile Beach but Stone (1937) questions Shick's identification abilities stating that Turnbull (1869) listed the species as "rare." McMullen, very active in the field especially as an egg collector, listed it as "very rare" (1938) in spite of his having found a nest and eggs in 1926 (McMullen 1947).

Fables (1955) referred to it as a "former breeder" but by 1959 the Urner Ornithological Club listed it as "regular but uncommon, since 1954" giving several occurrences since 1954. Recently it seems to be increasing slightly but consistently, especially in the Brigantine area (Kane and Farrar 1976), and in 1975 even expanded its breeding range to Long Island, New York (Buckley et al. 1975).

New Jersey has historically been at the northern end of the Gull-billed Tern's breeding range, and it was severely decimated by the millinery trade carnage that confronted most of our tern species on the entire Atlantic coast in the 1800's, when most of the more numerously populated southern breeding colonies were destroyed. Their recolonization of former breeding sites has been slow, and as late as 1961, a colony of 50 pairs in Virginia on Fisherman's Island was considered to be one of the largest colonies found recently (AFN Oct. 1961).

Gull-billed terns are primarily insectivorous in their food habits and regularly feed over the marshes catching insects, although they are known to feed on crustaceans, small fish, and amphibians (Bent 1921). They have even been observed preying on *Cnemidophorus* lizards in North

Carolina and feeding them to young, who were too small to swallow the entire lizard, and lay in their nests with the tails hanging from their bills as they slowly digested them (F.G. Buckley and P.A. Buckley pers. obs.). Their insect preferences may have also helped to keep their numbers reduced since New Jersey marshes were heavily treated with DDT in the mid-1900's which not only reduced insect populations but caused various problems for their predators as well.

Observations on the recent increases in Gull-billed Terns in New Jersey were supported by the 1976 N.J.A.S. survey which located at least 10 pairs along the coast. They are now regularly observed at Brigantine N.W.R. during the breeding season (Kane and Farrar 1976).

There is a possibility that a pair or two will be encountered in the specific study area in 1977 but this would be entirely fortuitous.

TABLE 39.

SPECIES: Gull-billed Tern

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	mid May		early June		late June	July
AVERAGE	early June		June		early July	late July
LATE			early August		mid July	August

REFERENCES: Buckley et al. 1975
McMullen 1947
Savell 1971

TABLE 40.

SPECIES: Gull-billed Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine Channel E.	8 Jun	2B	marsh is./ salt marsh	incub.	1975	Kane 1976
Brigantine Channel W.	5 Jun	4B	marsh is./ salt marsh	incub.	1975	Kane 1976
Coastal N.J.	early Jun	10 P			x	AB October 1976
Townsend Inlet	3 Jun	2B	barrier is./ grass, sand	pairing, territory formation		Kane 1976

TABLE 41.

SPECIES: Gull-billed Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Atlantic City vic.	1963 Jul	2N		eggs, young.		AB October 1963
	1963 1-10 Jul	2N				Cassinia 1964
Avalon	1974 12 Jun	6B				NJNN December 1974
	1974 25 May	8B				AB October 1974
	10 Jun	1N		eggs		AB October 1974
Avalon Causeway	1971 1-10 Jun	13N	roadside	eggs		Savell 1971
	1971 13 Jul			young, 4-5 days old	x	Savell 1971
	1971 4 Aug	8N		renesting	x	Savell 1971
Brigantine N.W.R.	1959	1P		summered		AFN October 1959
	1961 13 Aug	1B		2 young being fed		AFN October 1961
	1964 19 Jul	1B		2 young being fed		Cassinia 1964

(continued)

TABLE 41. (continued)

SPECIES: Gull-billed Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine N.W.R.	1974 mid Jun	4B				NJNN December 1974
	10 Aug			several immature birds		NJNN December 1974
Cape May	1811 Jul		salt marshes	eggs		Wilson 1814
Great Egg Harbor	1829 May-Jun	present				Burns 1929
Hereford Inlet	1954 19 Aug	1B		2 fledged young being fed		U.O.C. 1959
Longport vic.	1967 29 Jul	1N				NJNN December 1967
Moore's Beach (Avalon vic.)	1974 19 May	2B		courting		NJNN September 1974
Seven Mile Beach	1886		meadows, sand flats	nesting		Stone 1937
	1890	common	meadows, sand flats	nesting	x	Shick 1890

TABLE 41. (continued)

SPECIES: Gull-billed Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1927 3 Jul	1P				Cassinia 1927-1928
Somers Pt.	1958 29 Jun	1P		2 young banded		AFN October 1958, U.O.C. 1959
Stone Harbor	1926 20 Jun	1N	in LG col./	2 eggs	*	McMullen 1947
	1954 11 Jul	1N		downy young		AFN February 1955
Stone Harbor vic.	1958-1959	1P		nested		Rogers 1961
	1963 7 Jul	1N		2 eggs		Cassinia 1964
W. Cape May	1974 10 Jul-16 Aug	4B				NJNN December 1974

* First recorded nesting in New Jersey since 1800's

(concluded)

O. Forster's Tern

Sterna forsteri

Forster's Tern is a salt marsh nester and also feeds over the salt marshes in New Jersey and it is probably for this reason that it was not described as a New Jersey species by Wilson or Audubon, whose observations were made mostly on the barrier islands in New Jersey. There are several specimens in the U.S. National Museum which were, however, collected in New Jersey at Five Mile Beach by W. L. Abbott in the late 1800's. These specimens were collected during late April, May and June, in the company of breeding Common Terns (Stone 1909) so it is probable that they were also breeding in southern New Jersey at that time: Turnbull (1869) listed it as rare but he had found it breeding on Brigantine Beach. Shick's listing of species in 1890 as "formerly abundant" and not as common as it once was, has been regarded skeptically by Stone. By 1894, Stone listed the species as a "regular though rare transient and possible former breeder." In 1909, he referred to it as a "very rare straggler if it still occurs at all on the coast." It is not listed by Bent (1921) as breeding in New Jersey at all.

Birds of this species were, unfortunately, used in their entirety as ornaments in the millinery trade and were severely decimated. This, coupled with its marsh nesting habits and the difficulty earlier observers had in differentiating adults from the Common Tern (*Sterna hirundo*), makes it possible that its presence as a breeder in the early 1900's, while unlikely, might have been completely undetected.

In the late 1920's and early 1930's there was a sudden increase in the number of Forster's Terns appearing in coastal New Jersey during the post breeding dispersal and fall migration periods (Griscom 1923). However, Fables even by 1955 listed it as "not common" and only an "autumn transient."

The first recent nest was found at Brigantine National Wildlife Refuge by William Forward in 1956. It has increased since then as a breeder and the "First Supplement to the Annotated List of New Jersey Birds" (1959) listed it as a "summer visitant now reasonably common about the salt marshes......." The N.J.A.S. 1976 survey recorded 230 adults in six

colonies, which is probably a low count since their access to large areas of salt marsh was limited.

As Forster's Terns are primarily a salt marsh species, their presence at any specific study site would be unexpected so they will not be a major factor in the 1977 field study.

TABLE 42

SPECIES: Forster's Tern

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	late April				early June	late June
AVERAGE	early May		early June	23 days	June	July
LATE					July	August

REFERENCES: Bent 1921
Kane & Farrar 1976
Stone 1937

TABLE 43.

SPECIES: Forster's Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine N.W.R.	26 Jun	15B	marsh	newly fledged young	x	Kane & Farrar 1976
Dead Thorofare	2 Jun	50+B	salt marsh	egg laying		Kane 1976
Flat Creek	3 Jun	75B	salt marsh	incub.		Kane 1976
Somers Bay	4 Jun	4B	"spoil bank"/ adj. marsh		1975	Kane 1976
South Clam Bar	7 Jun	6B	salt marsh	incub.	x	Kane 1976
Swain Channel	2 Jun	80B	salt marsh	egg laying, incub., newly hatched young	x	Kane 1976

TABLE 44.

SPECIES: Forster's Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Avalon vic.	1967 5 Aug	1P		fledged		AFN October 1967
	1968 17 Jun	37N				AB October 1968
Brigantine Beach	1869		barrier is.	breeding		Stone 1937
Brigantine N.W.R.	1956 27 Jun	1N		eggs	*	AFN October 1956
	1956	3-5P		nested	*	Rogers 1961
	1959 22 Jul	8P		nested	x	Bull 1959
Nummy's Is.	1967 5 Aug			young being fed		NJNN December 1967
Seven Mile Beach	1890	not as common as before	barrier is.		x	Shick 1890
Stone Harbor Causeway	1968 1 Jun	5-6P				NJNN December 1968

* First recorded nesting in New Jersey since the 1800's

P. Common Tern

Sterna hirundo

Common Terns have nested in New Jersey at least since the early 1800's when Wilson (1813) found them breeding on the beaches in "great abundance" and Giraud (1844) noted their arrival in late April in both New Jersey and on Long Island. Shick writing in 1890 referred to them as "very common, still breeding on the beach at Seven Mile Beach." Stone (1894) however, called it "formerly an abundant summer resident." He states that the bird was almost exterminated by the millinery trade by 1883. Writing in 1909, Stone describes colonies of "hundreds or thousands" that were gone by 1893 and stated that Common Terns were reduced to a few small colonies. Stone (1894) also stated that he was familiar with them breeding in the salt marshes but did mention that he had been told they formerly bred abundantly on the sandy beaches as did the Least Terns (*Sterna albifrons*).

By the late 1800's or early 1900's Common Terns were reduced to small scattered colonies, nesting on the salt meadows (Burns 1929) and they still do not nest abundantly on any of the beaches today. Stone (1937) described their slowly increasing numbers after 1890 in southern New Jersey and indicated that they were more numerous in the Barnegat Bay area than in the Cape May region. By 1955, Fables referred to them as "a summer resident of the southern counties" and a "transient along the coast."

Common Tern is presently the most abundantly nesting tern in New Jersey but 73% of the 22 colonies in the 1976 N.J.A.S. survey (Kane and Farrar 1976) were on salt marshes where successful nesting can be marginal at best. According to Burger (pers. comm.; 1977d) the terns are facing increased competition from Herring Gulls for nest sites on dryer portions of the marsh. While the terns' adaptive ability to nest in the marshes as well as on open beaches no doubt helped to save them from complete extirpation during the gunning, egging and millinery slaughter phases of our ornithological history, any further loss of nest site alternatives because of increasing competition from gulls and human recreation interests may be terminal for this species in the northeast.

In 1976, the N.J.A.S. survey recorded 2295 adults while Burger and Lesser (1976) located 2830 nests in Ocean County alone. We do not know how successfully they nested but because of their salt marsh nesting proclivity there were probably considerable numbers overlooked.

Because this species nests on salt marsh adjacent to the dredged material islands in New Jersey they will be a consideration in the 1977 field studies.

TABLE 45.

SPECIES: *Common Tern*

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	early May		early May		early June	late July
AVERAGE	mid-late May		mid May- early June	21 days	mid June- early July	late July- early August
LATE			July		August	August

REFERENCES: Bent 1921
Burger & Lesser 1976
Burger pers. comm.
Cruickshank 1942
Kane & Farrar 1976
Stone 1937

TABLE 46.

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Avalon Causeway	3 Jun	22B	roadside			Kane 1976
Brigantine Channel E.	8 Jun	11B	marsh is./ salt marsh	incub.	1975	Kane 1976
Brigantine Channel W.	5 Jun	17B	marsh is./ salt marsh	incub.	1975	Kane 1976
mid Buster	25 May-10 Jun	182N	island/ salt marsh	nests		Burger & Lesser 1976
large Buster	25 May-10 Jun	287N	island/ salt marsh	nests		Burger & Lesser 1976
side Buster	25 May-10 Jun	164N	island/ salt marsh	nests		Burger & Lesser
small Buster	25 May-10 Jun	126N	island/ salt marsh	nests		Burger & Lesser
west Buster	25 May-10 Jun	67N	island/ salt marsh	nests		Burger & Lesser
Cape May Ferry Slip	1 Jun	10B	mainland/ sandy beach			Kane 1976

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Carvel Is. E.	25 May-10 Jun	45N	island/salt marsh	nests, eggs		Burger & Lesser 1976
Carvel Is. W.	25 May-10 Jun	46N	island/salt marsh	nests, eggs		Burger & Lesser 1976
Cedar Bonnet E.	25 May-10 Jun	2N	island/salt marsh	nests		Burger & Lesser 1976
Cedar Bonnet SE.	25 May-10 Jun	4N	island/salt marsh	nests, eggs		Burger & Lesser 1976
Cedar Bonnet SW.	25 May-10 Jun	37N	island/salt marsh	nests, eggs		Burger & Lesser 1976
Cedar Bonnet W.	25 May-10 Jun	3N	island/salt marsh	nests		Burger & Lesser
Cedar Creek	25 May-10 Jun	230N	island/salt marsh	nests		Burger & Lesser
Chadwick	9 Jun	275B	salt marsh is.	incub.		Kane 1976

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Clam Is. E.	25 May-10 Jun	9N	island/ salt marsh	nests	x	Burger & Lesser 1976
Egg Is.	25 May-10 Jun	13N	island/ salt marsh	nests, eggs		Burger & Lesser 1976
Flat Creek	25 May-10 Jun	33N	island/ salt marsh	nests		Burger & Lesser 1976
Ham Is.	25 May-10 Jun	16N	island/ salt marsh	nests, eggs		Burger & Lesser 1976
Ham Is.	7 Jun	5B	marsh is.	incub.		Kane 1976
Hester Sedge	25 May-10 Jun	6N	island/ salt marsh	nests		Burger & Lesser 1976
Holgate	5 Jun	52B	barrier is./ grass, sand	incub.	x	Kane 1976
Hospitality Cr.	4 Jun	10B	"spoil bank"/ adj. marsh	incub.		Kane 1976

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Island Beach	9 Jun	400+B	salt marsh		1975	Kane 1976
Lavallette S.	25 May-10 Jun	113N	island/ salt marsh	nests		Burger & Lesser 1976
Lavallette SW.	25 May-10 Jun	554N	island/ salt marsh	nests		Burger & Lesser 1976
Little Is.	7 Jun	33B	salt marsh is./ salt marsh	incub.	1975	Kane 1976
	25 May-10 Jun	235N	island/ salt marsh	nests		Burger & Lesser 1976
Little Beach Is.	25 May-10 Jun	83N	island/ salt marsh	nests		Burger & Lesser 1976
Little Beach N.	6 Jun	100B	barrier is./ herb grass, sand cobble	incub.	x	Kane 1976
Log Creek	25 May-10 Jun	28N	island/ salt marsh	nests, eggs		Burger & Lesser
Log Creek W.	25 May-10 Jun	66N	island/ salt marsh	nests, eggs		Burger & Lesser

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Long Beach Is. Causeway N.	4 Jul		roadside fill	young present		Kane pers. comm.
Long Point E.	25 May-10 Jun	32N	island/ salt marsh	nests		Burger & Lesser 1976
Long Point W.	25 May-10 Jun	43N	island/ salt marsh	nests		Burger & Lesser 1976
Middle Is.	6 Jun	2B	"spoil bank"/ salt marsh	incub.		Kane 1976
Middle Sedge	6 Jun	6B	marsh is./ salt marsh	incub.	1975	Kane 1976
	25 May-10 Jun	115N	island/ salt marsh	nests		Burger & Lesser 1976
Mordecai Is.	25 May-10 Jun	2N	island/ salt marsh	nests		Burger & Lesser 1976
	7 Jun	15B	salt marsh is./	incub		Kane 1976
Muddy Hole	2 Jun	20B	salt marsh	incub.		Kane 1976
NW. Point	25 May-10 Jun	104N	island/	nests, eggs		Burger & Lesser 1976
Pelican Is.	9 Jun	2B	"spoil bank"			Kane 1976

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Pettit Is.	25 May-10 Jun	29N	island/ salt marsh	nests, eggs		Burger & Lesser 1976
Pork Is.	4 Jun	65B	marsh is./ salt marsh	incub.		Kane 1976
Sandy Hook	20 Jun	500B	mainland sandy beach	incub.	x	Kane 1976
Sandy Is.	25 May-10 Jun	1N	island/ salt marsh	nests		Burger & Lesser 1976
Sloop Sedge E.	25 May-10 Jun	12N	island/ salt marsh	nests, eggs	x	Burger & Lesser 1976
Sloop Sedge W.	25 May-10 Jun	87N	island/ salt marsh	nests, eggs	x	Burger & Lesser
Somers Bay	9 Jun	30B	"spoil bank"/	incub.	1975	Kane 1976
South Cape May	1 Jun	15B	mainland/ sand cobble			Kane 1976
South Channel	3 Jun	16B	salt marsh	incub.		Kane 1976
SW. Cove Pt.	1 Jun	700B	salt marsh	incub.		Kane 1976

(continued)

TABLE 46. (continued)

SPECIES: Common Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Vol Sedge	8 Jun	7B	salt marsh is.	incub.	1975	Kane 1976
Vol Sedge E.	25 May-10 Jun	1N	island/ salt marsh	nests		Burger & Lesser 1976
Vol Sedge W.	25 May-10 Jun	55N	island/ salt marsh	nests, eggs	x	Burger & Lesser 1976

(concluded)

TABLE 47.

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Atlantic City	1893 23 Jul			2 downy young		Philadelphia Academy of Science Coll.
	1893 Jul	several P	salt meadows	young		Stone 1894
	1926 4 Jul			hatching		Miller 1926
Avalon Causeway	1970 1 Aug		"spoil"	nested		NJNN September 1972
	1971 Jun	500P	roadside fill	nested, young banded 8-21 August	x	Savell 1971
	1974 10 Jun		"fill"	nests	x	Fisk 1974
	30 Jun			well-grown chicks	x	Fisk 1974
Brant Beach	1936 9 Aug			"highly incubated eggs"		Miller 1937
	1938 14 Jul			young banded		Austin 1949
	1940			young		Austin 1951
Brigantine	1929 9 Jun			"highly incubated eggs"		Miller 1930
Brigantine Is.	1921 17-18 Jul	300B		hatching, young fledglings		Stone 1937

(continued)

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine Is.	1933 25 Jul			"half-incubated eggs"		Miller 1934
	1935 30 May			"fresh eggs"		Miller 1937
	1947	good numbers	barrier is.			AFN September 1947
Cape May	1941 27 Jun			eggs		Miller 1941a
Clam Is.	1975	9P	*Spartina*	eggs in May		Burger pers. comm.
Egg Is.	1926	2017B		nesting		Hilliard 1926
	1975	60P	*Spartina*	nested		Burger pers. comm.
Elder Is.	1969 21 Jul			colony washed out		AFN October 1969
Ephraim's Is.	1928 28 Jul		low meadow Is./ dredged sand	eggs, young		Stone 1937
	4 Aug	800-1000B				Stone 1937
	1929 11 May	250B		courting	x	Stone 1937
	30 Jun	200B		young	x	Stone 1937

(continued)

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Ephraim's Is.	1930 16 May	50B	low meadow is./ dredged sand	courting	x	Stone 1937
	21 Jul	20P		eggs, young	x	Stone 1937
	1931 6 Jul	4B		eggs washed out	x	Stone 1937
Ephraim's Is. 1 mile north	1932 13 Jul	200B	"dredging on meadows"	eggs, downy young		Stone 1937
Five Mile Beach North	1923 20 Jun	200B				Stone 1937
	1924 21 Jul	15P		eggs, young, fledglings		Stone 1937
Gull Is.	1900 30 Jun			eggs ready to hatch		Clapp pers. comm.
Ham Is.	1963 30 Jun			nested		Frohling 1965
Hereford Inlet (Gull Bar)	1923 20 Jun	300B		eggs, downy young		Stone 1937
	1926 11 Jul	72N		eggs, downy young	x	Stone 1937
Holgate Beach	1974 1 Jul	100B	barrier is.	young		Fisk 1974

(continued)

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Holgate South	1947 5 Jul	large	sandbar	eggs		Fry 1948
Little Beach Is.	1916 7 Jul		barrier is.	nesting		Street 1916
	1947 26 Jul	20B	beach			Kramer 1948
	1974-1975	35P	barrier is.	nested	x	Burger pers. comm.
Long Beach Is.	1947	good numbers	barrier is.			AFN September 1947
Longport	1939 10 Jun			eggs		Miller 1940
Peck's Beach	1900 30 Jun			eggs ready to hatch		Clapp pers. comm.
Sandy Hook	1974 11 Jun	5P	mainland/ sandy beach	nests, eggs		Buckley & Buckley 1974
	1975 11 Jun	200P		nests, eggs	x	Buckley & Buckley 1975
Seven Mile Beach	1890	was very common	sand flats,			Shick 1890
	1921 26 Jun	15P	barrier is.	eggs		Stone 1937

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1922 25 Jun	60P	barrier is.	eggs		Stone 1937
	1925 11 Jun	5P				Stone 1937
	1927 19 Jun	100N		"2/3 incubated eggs"		Miller 1928
	9 Jul	50P		eggs, young	x	Stone 1937
	24 Jul	500B			x	Stone 1937
Seven Mile Beach (south)	1921 26 Jun	4N	barrier is./ beach	eggs	x	Stone 1937
	3 Jul	8N		eggs	x	Stone 1937
	10 Jul	6N		eggs	x	Stone 1937
	17 Jul	3N		eggs	x	Stone 1937
	1922 18 Jun	46N		eggs	x	Stone 1937
	25 Jun	50N		eggs	x	Stone 1937
	1923 17 Jun	5P		eggs	x	Stone 1937
	8 Jul	several P		eggs	x	Stone 1937
	1924 22 Jun	75P		eggs, hatching	x	Stone 1937
	29 Jun	54N		eggs, downy young	x	Stone 1937
	4 Jul	43N		eggs	x	Stone 1937

(continued)

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach (south)	1925 7 Jun	4N		eggs	x	Stone 1937
	1927 19 Jun	50P	barrier is./ beach	eggs	x	Stone 1937
	3 Jul	81N		eggs, downy young	x	Stone 1937
	1928 24 Jun	many		eggs, young	x	Stone 1937
	1931 4 Jul	50B		eggs, young	x	Stone 1937
	1932 26 Jun	4P	eggs		x	Stone 1937
	1936 16 May	10P		courting	x	Stone 1937
	7 Jun	15P		eggs	x	Stone 1937
	20 Jun	50N		eggs, young	x	Stone 1937
Sloop Is. E.	1971	400N	island/ salt marsh	nested		Burger pers. comm.
	1973	250N		nested	x	Burger pers. comm.
	1975	150N		nested	x	Burger pers. comm.
Sloop Is. W.	1971	200N	island/ salt marsh	nested		Burger pers. comm.
	1973	250N		nested	x	Burger pers. comm.
	1975	100N		nested	x	Burger pers. comm.

(continued)

TABLE 47. (continued)

SPECIES: Common Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor	1924 22 Jun			"fresh eggs"		Miller 1924
	1928 24 Jun			"highly incubated eggs"		Miller 1928a
	1930 15 Jun			eggs		Miller 1931
	1931 4 Jun			"highly incubated eggs"		Miller 1932
	1932 26 Jun			"highly incubated eggs"		Miller 1933
	1938 26 Jun			hatching eggs		Miller 1939
Stone Harbor Promontory	1963 14 Jul			nesting		NJNN Sept. 1963
Stone Harbor vic.	1953 18-24 May	22+N	grass tussocks	eggs		Gemperle & Preston 1955
Tuckerton vic	1953	4000B	sand is.	bred		AFN October 1969 Nisbet 1973
Wildwood	1925 21 Jun			"highly incubated eggs"		Miller 1925

(concluded)

Q. Roseate Tern

Sterna dougallii

Roseate Tern was once an abundantly breeding species in New Jersey in the early 1800's (Stone 1894). Baird et al. (1884) described it as breeding in New Jersey in considerable numbers on the coast, where eggs were collected in 1840. Stone (1909) describes it as a "rare straggler" and cites Turnbull's (1969) description of it as "not uncommon" and Shick' (1890) described it as "less plentiful than it was in 1885 when it was easy to gather several bushels of eggs in a few hours."

It nested in association with Common Terns, generally in denser vegetation than the former, and was, like them, wiped out by the millinery trade gunners in combination with heavy egging (Bent 1921; Giraud 1844).

By 1937, the species seemed to be returning as a breeding species in New Jersey (Stone 1937) though not abundantly and it was probably often overlooked, since it was no doubt difficult to identify within colonies of the more numerous Common Terns. In 1955 Fables described it as a rare summer resident of the south Jersey coast, noting that "probably a few pairs still bred on the coastal islands." By 1959 the Urner Ornithological Club listed it as "probably not as rare a transient as generally believed."

It is still not easily or commonly found nesting in New Jersey though a few pairs probably do nest every season. The increasing presence of Herring Gulls and Great Black-backed Gulls at nesting sites formerly used by Common Terns (Burger and Shisler 1976) and suitable for Roseate Terns probably limits the nesting possibilities for Roseate Terns in New Jersey. They are far more numerous to the north on eastern Long Island, the species' center of abundance in the western hemisphere.

TABLE 48.

SPECIES: Roseate Tern

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY			late May		late June	late June
AVERAGE	late May- early June		June	21 da.	early July	July
LATE			July		July	August

REFERENCES: Bent 1921
Cruickshank 1942
Stone 1937

TABLE 49.

SPECIES: Roseate Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat Bay	29 Jun	1N	island	nested		AB Oct. 1976
Sandy Hook	9 Jun	2B	mainland/ beach sand	courting		Buckley & Buckley 1976

TABLE 50.

SPECIES: Roseate Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Barnegat Bay	1934	2P	island			Stone 1937
	1948	2P	in CT col.			AFN Oct. 1948
Brigantine	1929 9 Jun	1N		2 "highly incubated eggs"		Miller 1930
	1940 30 May			nesting		Cassinia 1940
Brigantine Is.	1974 9 Jul		barrier is.			NJNN Dec. 1974
Five Mile Beach (north)	1932 13 Jul	1P	"filled meadow"			Stone 1937
Gull Bar (Hereford Inlet)	1923 20 Jun	1P	sand shoal			Stone 1937
	1924 20 Jul	1P	sand shoal	fledging	x	Stone 1937
Little Egg Inlet	1971 16 Jul	1N		eggs		Cassinia 1971
Sandy Hook	1973 13-14 Jun	20P	natural beach	loafing		Downing 1973

(continued)

TABLE 50. (continued)

SPECIES: Roseate Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Seven Mile Beach	1885	once comm.	barrier is.	nested		Shick 1890
	1927 3 Jul	1N		eggs		Miller 1928
Stone Harbor	1928 24 Jun	1N		"highly incub. eggs"		Miller 1928a
Tucker's Beach	1944 2 Jul	1N		eggs		Cassinia 1944

(concluded)

R. Least Tern

Sterna albifrons

Least Tern, our smallest tern, was once found nesting in great abundance on the unspoiled barrier beaches of New Jersey. Wilson (1813) found it in large numbers on Peck's Beach and it was an abundant summer resident along the coast until the millinery trade hunters nearly exterminated the species (Stone 1894) in the 1880's. The highly desirable adults were used mounted on ladies' hats in their entirety.

In 1909, Stone wrote that it is a "very rare straggler" but by 1937 the species had begun to increase and could again be found breeding on New Jersey beaches. Fables (1955) described it as a "summer resident on the relatively undisturbed barrier beaches .....and on man-made sand fills."

More recent surveys of the species in New Jersey (Downing 1973; Fisk 1974; Kane and Farrar 1976) indicated the species is not doing as well as it should. Galli (1975) stated that in 1974 only 16 colonies were found totalling only 410 nesting pairs; in 1976, 24 colonies with 1388 birds were located. These figures are misleading because indications are that the birds were not all nesting successfully (Galli 1975) and efforts are underway in New Jersey to have Least Tern placed on the New Jersey State "Endangered Species" list (Kane pers. comm.).

Least Terns require bare sand as nest sites. Because of beach development their traditional nesting sites are decreasing, with human disturbance and mammalian predation also contributing to their decline. They are able to nest on construction fill sites (Downing 1973) but these locations are ephemeral and subject to great activity during the nesting season. In Florida (Fisk 1975), the birds have resorted to nesting on flat roof tops but this is a highly unlikely alternative in New Jersey.

Least Terns are not too common on the dredged material islands in New Jersey, seeming to prefer barrier beach island locations. If they are encountered in the specific study sites in 1977, they will be a bonus.

TABLE 51

SPECIES: Least Tern

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY			late May	20 da.	mid June	
AVERAGE	late May- early June		early June	22 da.	late June	mid July
LATE				25 da.	early July	

REFERENCES: Fisk 1974
Kane 1976
Massey 1974
Miller 1928a
Stone 1937

TABLE 52.

SPECIES: Least Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Absecon Blvd.	5 Jun	12B	roadside fill/ sand	pairing, terr. form.		Kane 1976
Absecon Blvd. W.	4 Jun	2-12B	roadside fill/ sand	pairing, terr. form.		Kane 1976
Absecon Inlet N.	4 Jun	125+B	barrier is./ grass, sand	eggs		Kane 1976
Avalon Causeway	3 Jun	4B	roadside fill			Kane 1976
Barnegat Inlet	9 Jun	67B	barrier is./ sand cobble			Kane 1976
Bass Harbor	4 Jun	2B	"spoil bank"	eggs		Kane 1976
Cape May Ferry Slip	1 Jun	34B	mainland	pairing, egg laying	x	Kane 1976
Corson's Inlet N.	3 Jun	47B	barrier is./ grass, sand	pairing, terr. form.		Kane 1976
Drag Is.	3 Jun	10B	"spoil bank"/ grass, sand	nest scrapes, pairing		Kane 1976
Holgate	5 Jun	67B	barrier is./ grass, sand			Kane 1976

(continued)

TABLE 52 (continued)

SPECIES: Least Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Hospitality Creek	4 Jun	10B	"spoil bank"	eggs		Kane 1976
Longport Sod Banks	4 Jun	10B	barrier is./ grass, sand	pairing, terr. form.		Kane 1976
Magnesite Plant (Cape May)	1 Jun	14B	"spoil bank"/ sand	terr. form., egg laying	x	Kane 1976
Newark Airport	27 Jun	80B	"sandfill"			Kane 1976
Pelican Is.	9 Jun	47B	"spoil bank" grass, sand	incub.		Kane 1976
Peter Beach	5 Jun	300B	barrier is./ sand		1975	Kane pers. comm.
Port Newark	5 Jun	30B	landfill/ sand	egg laying		Kane 1976
Sandy Hook	20 Jun	250B	mainland/ sand cobble	eggs, young	1975	Kane 1976
Seven Mile Beach	2 Jun	44B	barrier is./ sand	pairing, terr. form.	1975	Kane 1976
South Cape May	1 Jun	50B	mainland/ sand cobble	egg laying, incub.	x	Kane 1976

(continued)

TABLE 52 (continued)

SPECIES: Least Tern 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Two Mile Beach I	1 Jun	10B	barrier is./ sand cobble	pairing, terr. form.		Kane 1976
Two Mile Beach II	1 Jun	16B	barrier is./ sand cobble	pairing, terr, form.		Kane 1976
Ventnor City	4 Jun	10B	landfill/ "spoil"	pairing, terr, form.		Kane 1976
Whale Beach	3 Jun	20B	barrier is./ sand, grass	pairing, terr. form.		Kane 1976

(concluded)

TABLE 53.

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Avalon Causeway	1971	100P	roadside fill	nested		Savell 1971
Avalon Causeway (north)	1974 26 May	16P	sand flat/ Phrag, sand	eggs		Fisk 1974
	10 Jun	12-15P		eggs	x	Fisk 1974
	21 Jun	45-50B		nests	x	Fisk 1974
	24 Jun	12-15P		eggs	x	Fisk 1974
	30 Jun			nests, 1 young	x	Fisk 1974
Beach Haven (S. tip beach)	1973 13-14 Jun	50+P	"development spoil"			Downing 1973
Brigantine	1928 17 Jun			"newly hatched chicks"		Miller 1928a
	1935 30 May			"fresh eggs"		Miller 1935
	1939 20 Jun			"highly incub. eggs"		Miller 1940
Brigantine Beach	1921 7 Jun	12N		eggs		Stone 1937
	1922 25 Jun	22N		eggs		Stone 1937

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine Beach	1926 24 Jun	15N		eggs		Stone 1937
	1933 11 Jun	90N		eggs		Stone 1937
	1973 13-14 Jun	75-100P	"development spoil"	4 nests		Downing 1973
Brigantine Is.	1920	1+P				Stone 1937
	1947	good nos.	barrier is.	nested		AFN September 1947
	1974 27 May	75-100P	"construction spoil"			Fisk 1974
	1974	2/3 decr.				NJNN Dec. 1974
Burlington Co.	1916 12 Jun	2 sm. col.		eggs		Harlow 1918
Cape May	1941 15 Jun	20B	along road	nesting		U.S. Natl. Mus.
Cape May Pt.	1974 1 Jul	32N	"fill"	eggs		Fisk 1974

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST DUE	REFERENCE
Corson's Inlet	1925	31N		eggs		Stone 1937
	14 Jun					
	28 Jun	13N		eggs		Stone 1937
	11 Jul			eggs, young		Stone 1937
	1926	30P		eggs, young		Stone 1937
	27 Jun					
	1927	5N		eggs		Stone 1937
	21 May					
	12 Jun	50P		eggs, young		Stone 1937
	3 Jul			eggs		Stone 1937
	1928	25N		eggs		Stone 1937
	26 May					
	1932	52N		eggs		Stone 1937
	4 Jun					
Corson's Inlet	1924	20P	sand spit			
(Ludlam's Is.)	1925			eggs	x	Stone 1937
	29 May					
	1927			courting	x	Stone 1937
	20 May					
	16 Jul			fledging	x	Stone 1937

(continued)

TABLE 53 (continued)

SPECIES: Least Terns

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Egg Harbor Br.	1974 27 May	20-25P	"vegetating spoil			Fisk 1974
	8 Jun	20N		4 chicks	x	Fisk 1974
Fortesque vic.	1955			nested		Rogers 1961
Hackensack Meadows	1973 Jul-Aug	100+B	"sandfill"	nests (3)		Kane 1974
Harvey Cedars	1973 13-14 Jun	30P	"development spoil"	nests (10)		Downing 1973
Holgate	1938 30 May			"fresh eggs"		Miller 1939
	1941 8 Jun			"highly incub. eggs"		Miller 1941a
Holgate Beach	1972	124P	barrier is.	186 young produced		Downing 1973
Holgate South	1947	large				Fry 1948
Little Beach Is.	1969 22 Jun	6N	barrier is.	nests		NJNN September 1969
Long Beach	1879	abund.	barrier is.			Stone 1937

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Long Beach	1947	good nos.	barrier is.	nested		AFN September 1947
Mantoloking	1973 13-14 Jun	50P		18 nests, 2 young		Downing 1973
Ocean City	1926 27 Jun			chicks		Miller 1926
	1933 18 May			nests		Miller 1934
	1973 13-14 Jun	10P	"development spoil"			
Peck's Beach	1810	great abundance				Wilson 1813
	1926 30 May	11N		eggs	x	Stone 1937
	1931 7 Jun	71N		eggs	x	Stone 1937
	1927 12 Jun	50N		eggs, nests		Miller 1928

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Peck's Is.	1886 28 Jun			eggs		U.S. Natl. Mus. Coll.
Sandy Hook	1973 13-14 Jun	100+P	natural beach			Downing 1973
	1974 11 Jun	71P	mainland/ beach sand	nests, eggs	x	Buckley & Buckley 1974
	1975 25 May	80P		nests	x	NJNN August 1975
	11 Jun	30P		nests	x	Buckley & Buckley 1975
Sea Isle City vic.	prior to 1890	many 100's of prs.	sm. sand flat		x	Shick 1890
	1928 20 May	20N	"fill"	nests		Stone 1937
Seaside Hts.	1973 13-14 Jun	75-100P	"development spoil"			Downing 1973
Secaucus	1974 May-Jun	15P	"sandfill"	young		Fisk 1974

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Secaucus	1974 17 Jun	12P	"sandfill"	eggs		NJNN December 1974
Seven Mile Beach	1885 24 Jun			eggs		U.S. Natl. Mus. Coll.
	1888	30P				Stone 1937
	1892	few P				Stone 1937
	1899	2B				Stone 1937
Seven Mile Beach (south)	1925 5 Jul	2N		eggs, young		Stone 1937
	1935 16 Jun	9N		eggs		
	1936 7 Jun	25P				
Stone Harbor	1925 25 Jul			"highly incub. eggs"		Miller 1925
	1955 10 Jul			young		Clapp 1975
Stone Harbor vic.	1953 18-24 May	2N	shell, sand flats	eggs		Gemperle & Preston 1955

(continued)

TABLE 53 (continued)

SPECIES: Least Tern

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Stone Harbor vic.	1960	colony		nested		Rogers 1961
	1974 26 May	22P	"construction spoil"			Fisk 1974
Tuckerton	1974 10 Jun	12N		eggs		Fisk 1974
Two Mile Beach	1937 Jun	colony	sand flats			Stone 1937

(concluded)

S. Black Skimmer
Rynchops nigra

Black Skimmer was once an abundant nester on the sand bars and flat beach fronts of southern New Jersey in the early 1800's and was common until about the 1880's. Wilson (1814) described Black Skimmer as laying its eggs in early June and recounted the collection of "half a bushel or more" from one sand bar 0.5 acres in size. Skimmers were heavily egged though they were not hunted for the millinery trade. (Bent 1921) attributes their decrease in New Jersey to the "encroachments of civilization" but Stone (1894) listed them as "now quite rare" at about the time in the 1880's that the terns were being driven from the beaches in New Jersey by the millinery slaughterers. Shick (1890) also noted that "they are quite scarce but that several years previously they were more common." It is likely that the gunners shooting the terns on the beaches combined with seaside development pushed the skimmers from the beaches.

Stone (1937) stated that they were very local during the breeding season and small numbers in scattered colonies may have been overlooked in more remote areas. It is possible that they survived, as did the Common Terns, in small numbers on the islands in the bays and salt meadows behind the barrier beaches. Frohling (1965) described their nesting on the salt marsh islands between Barnegat and Beach Haven Inlets, so it was possible that small numbers nested throughout this period in small isolated areas and were overlooked.

Their numbers, however, started increasing in the 1920's along the coast and by the 1930's there were a number of larger colonies where banding activities were a yearly activity (Stone 1937). Cruickshank (1942) chronicled the species' breeding range expansion to Long Island, New York in 1934 but noted that it was not found breeding above Asbury Park in New Jersey. By 1955, Fables listed it as "a summer resident on the barrier beaches and southern islands in the southern part of the state" and Rogers (1961) listed it as "locally abundant" on the southern half of the New Jersey coast.

In 1975 a few bred successfully at Sandy Hook in the northern part of the state and in 1976 they nested again but half their 60 eggs were vandalized over a weekend when a nearby beach area was opened by the National Park Service to accommodate overflow crowds, in spite of the beach area where the birds were nesting having been marked "closed for protection." This unfortunate incident reflects the desperate situation of all open sand and beach nesting species in New Jersey.

While the 1976 N.J.A.S. survey located 1000 nesting pairs (Kane and Farrar 1976), two traditionally large colony nesting areas (Seven Mile Beach and Gravens Island) were not productive.

Skimmers should be an important species on the dredge material islands in New Jersey but despite severe disturbance they seem to prefer the beach front locations on the barrier islands. Their later nesting period places them in direct conflict with human recreational use of these areas possibly a major reason for their recent decrease in numbers. I am hopeful that they will be encountered on some of the specific study site areas but we cannot be certain that they will be.

TABLE 54.

SPECIES: Black Skimmer

DATE	PAIRING	TERRITORY FORMATION	EGG LAYING	INCUBATION	HATCHING	FLEDGING
EARLY	mid May		early May		early June	early July
AVERAGE	late May-early June		May-June	22-24 da.	June-July	July-August
LATE			August		September	September

REFERENCES:

Burger pers. comm.
Cruickshank 1942
Kane & Farrar 1976
Savell 1971
Stone 1937

AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3
USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166

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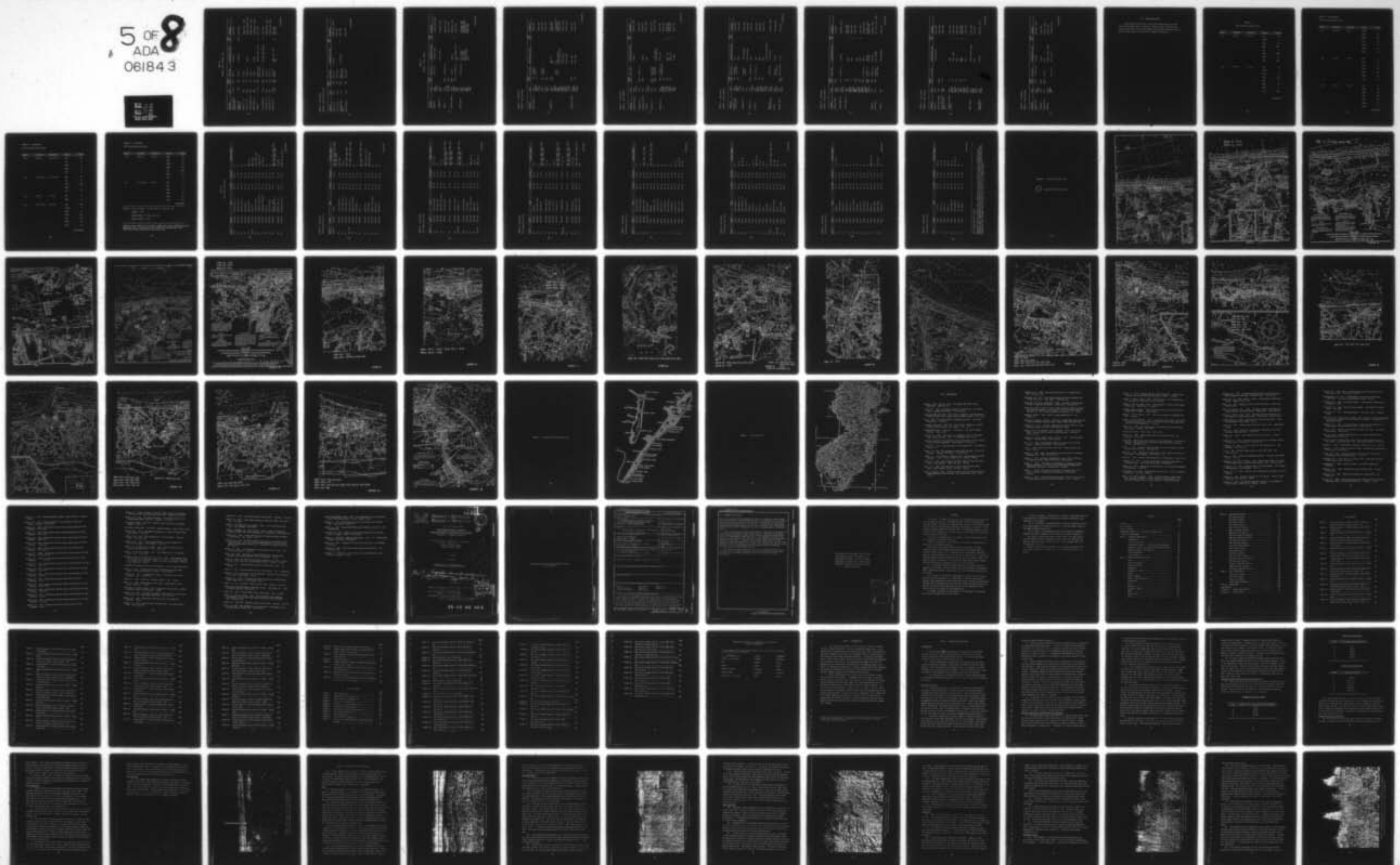


TABLE 55.

SPECIES: Black Skimmer 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Avalon Causeway (north side)	26 Jun	130B	"fill"	courting		Kane 1976
Brigantine Channel E.	8 Jun	24B	marsh is.	"loafing"	1975	Kane 1976
Carvel Is. E.	1976	16N	island			Burger pers. comm.
Carvel Is. W.	1976	12N	"spoil is."	nested		Burger & Lesser 1976
Cedar Bonnet S.W.	1976	6N	island			Burger pers. comm.
Cedar Creek Is.	1976	8N	island	nested		Burger pers. comm.
Holgate	5 Jun	728B	barrier is./ grass, sand	pairing, terr. form.	x	Kane 1976
Little Beach N.	6 Jun	412B	barrier is.	pairing, egg laying	x	Kane 1976
Log Creek Is. E.	1976	14N	marsh is.			Burger pers. comm.
Log Creek Is. N.	1976	21N	marsh is.			Burger pers. comm.
Sandy Hook N.	20 Jun	50B	mainland	eggs, terr. form.	x	Kane 1976
	7 Jul	50B	beach	eggs	x	Kane 1976

(continued)

TABLE 55. (continued)

SPECIES: Black Skimmer 1976

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Sloop Is. W.	1976	50N	marsh is.	nested		Burger pers. comm.
S.W. Cove Pt.	1 Jun	20B	salt marsh			Kane 1976
Strathmere Bay Marsh	3 Jun	700B	marsh is./ "spoil bank"	pre-nesting	x	Kane 1976
Swain Channel	2 Jun	40B	salt marsh			Kane 1976

(concluded)

TABLE 56

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Anglesea	1932 28 May		barrier is.	breeding colony	x	Cassinia 1931-1932
Anglesea Is.	1923-1927			yng. raised		Gillespie 1931
Avalon	1974 12 Jun	1700B	mainland fill			NJNN Dec. 1974
	21 Jul	500P				AB Oct. 1974
Avalon Causeway	1970 1 Aug	2000B	"spoil"	nested	x	NJNN Sept. 1972
	1971 June	700P	roadside fill	yng. banded on 8-21 Aug	x	Savell 1971
Brant Beach	1928		barrier beach	yng. raised		Gillespie 1931
	1929			yng. raised		Gillespie 1931
	1930			yng. raised		Gillespie 1931
	1931			colony present		Stone 1937
	1936 9 Aug			yng.		Miller 1937

(continued)

TABLE 56. (continued)

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brant Beach vic.	1925 30 June	1P	"dredge"/ sand is.			Stone 1937
	1926 25 Jul	6P				Stone 1937
	1927	30P	"dredge"/ sand is.			Stone 1937
	1928- 1937	to 75P				Stone 1937
Brigantine	1921	25P		eggs,yng.		Stone 1937
	1924 17 Aug	40B		yng.		Stone 1937
	1930		barrier	yng.		Gillespie 1931
	1931		beach	colony present		Stone 1937
	1933 25 Jul			"half incub. eggs"		Miller 1934
	1935 8 Jun			"fresh eggs"		Miller 1934
	1939 20 Jun			"fresh eggs"		Miller 1940
Brigantine Beach	1921 18 Jun	13+N		eggs, yng.		Stone 1937
	1922 25 Jun	22N		nest, eggs		Stone 1937

(continued)

TABLE 56. (continued)

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Brigantine Inlet	1967 14 Sept			nesting		AFN Feb. 1968
Brigantine Is.	1877	abund.	barrier is.			Stone 1937
Brigantine N.W.R.	1975	500P		nested		Clapp 1975
Cape May	1941 27 Jun			eggs		Miller 1941a
Cape May Co.	1810	numer-ous	sand bars, sand flats			Wilson 1814
	1948	500B	4 colonies	in Cape May & Ocean Counties		AFN Oct. 1953
Ephraim's Is.	1928 10 Aug	80B	lo marsh is./ "dredged sand"	downy yng.		Stone 1937
	1929 11 May	25B			x	Stone 1937
	30 Jun	50B		eggs, yng.	x	Stone 1937
	17 Jul			yng.	x	Stone 1937
	1930 4 Jul	40P		eggs, yng.	x	Stone 1937
	4 Aug			fledged	x	Stone 1937

(continued)

TABLE 56. (continued)

SPECIES: BLACK SKIMMER

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Ephraim's Is. 1 mile north	1931 29 Jul	40P	"dredging on meadows"	yng.		Stone 1937
	1932 13 Jul	60B		eggs	x	Stone 1937
Goosebar Is.	1930		"dredge"/ sand is.	colony present		Stone 1937
	1931			colony present	x	Stone 1937
Gravens Is.	1974 25 May	1500B	roadside fill	eggs		Fisk 1974
Gull Bar	1923 8 Jul	40B	sand shoal	eggs		Stone 1937
	1925 21 Jun	8N		eggs	x	Stone 1937
	1926 11 Jul	75B		eggs	x	Stone 1937
	10 Aug			eggs,yng.,fledglings		
Gull Bar (Grassy Sound)	1948 9 Sept		sandy shoal	10 downy yng.		AFN Feb. 1949
Ham Is.	1963 30 Jun		island/ salt marsh	nested		Frohling 1965
Holgate Beach	1974 1 Jul	550-700B	barrier beach	2 yng.		Fisk 1974

(continued)

TABLE 56. (continued)

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Holgate South	1947 5 Jul	large				Fry 1948
Island Beach S.	1947 26 Jul	50B	barrier is.	nesting		AFN Sept. 1947
Little Beach Is.	1910	2P				Stone 1937
	1915 15 Jul	2N		eggs	x	Stone 1937
	1916 17 Jun	1N		eggs	x	Stone 1937
	1921	5P			x	Stone 1937
	1925 15 Jul	mny.		eggs	x	
	1931 16 Jun	132N		eggs	x	Stone 1937
	1936 14 Aug	500B	barrier is.	nests		Cassinia 1936
	1947 26 Jul	100B 200B	barrier is. beach	nesting nesting		AFN Sept. 1947 Kramer 1948
Longport	1947	200B	barrier is.	nesting		AFN Sept. 1947
Sandy Hook	1975	20B	mainland/ sandy beach	yng. fledged		Rec. N.J.B. Nov. 1975
Sandy Is.	1931			colony present		Stone 1937

(continued)

TABLE 56. (continued)

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Shad Is.	1931			colony present		Stone 1937
Seven Mile Beach	1890	scarce				Shick 1890
Seven Mile Beach (Sea Isle City vic.)	1885-1886	75+N				Burns 1929
Seven Mile Beach (south)	1921 26 Jun	1N		eggs		Stone 1937
	1922 25 Jun	3P		nests, eggs	x	Stone 1937
	1931 6 Jun	11N		eggs	x	Stone 1937
	4 Jul	7N		eggs	x	Stone 1937
	1935 16 Jun	7N		eggs	x	Stone 1937
	1936 20 Jun	6N		eggs	x	Stone 1937
Stone Harbor	1931 4 Jul			"partly incub. eggs"		Miller 1925
	1934 5 Aug			yng.		Cook 1942
Stone Harbor Promontory	1963 14 Jul			nesting		NJNN Sept. 1963

(continued)

TABLE 56. (continued)

SPECIES: Black Skimmer

LOCATION	DATE	COLONY SIZE	SITE TYPE	REPRODUCTIVE STAGE	PAST USE	REFERENCE
Tucker Beach vic.	1947 26 Jul	400B	sand island	nesting		AFN Sept. 1947
Tuckerton	1953	2000B		nested		Clapp 1975
Tuckerton vic.	1953	4000B	sand is.	bred		AFN Oct. 1953
Wildwood	1925			"highly incub. eggs"		Miller 1925
	21 Jun 1929		barrier is.	yng. raised		Gillespie 1931

(concluded)

VII. SURVEYS AND MAPS

Tables listing the results of the 1975 fixed-wing heron survey (Custer and Osborn 1975); a summary of species found at nesting locations in 1976 (Kane 1976); maps showing 1976 nesting locations; maps of the New Jersey coast in 1937 and 1977 comprise section VII.

TABLE 57.

1975 Fixed Wing Heron Survey

COLONY #	LATITUDE	LONGITUDE	SPECIES	# ADULTS
155	39° 30'	74° 46'	LBH	44
			CATEG	6
			GREG	720
			SNEG	2440
			LAH	14
			BCNH	2180
			YCNH	10
			GLIB	2640
156	38° 59'	74° 52'	LBH	16
			CATEG	4
			GREG	10
			SNEG	250
			LAH	6
			BCNH	60
			YCNH	6
			GLIB	800

(continued)

TABLE 57. (continued)

1975 Fixed Wing Heron Survey

COLONY #	LATITUDE	LONGITUDE	SPECIES	# ADULTS
157	38° 59'	74° 51'	CATEG	8
			GREG	84
			SNEG	170
			LAH	20
			BCNH	34
			YCNH	10
			GLIB	40
158	39° 07'	74° 44'	GNH	4
			LBH	76
			GREG	50
			SNEG	472
			BCNH	234
			YCNH	100
			GLIB	50
159	39° 17'	74° 35'	LBH	24
			CATEG	20
			GREG	60
			SNEG	950
			LAH	16
			BCNH	70
			YCNH	4

(continued)

TABLE 57. (continued)

1975 Fixed Wing Heron Survey

COLONY #	LATITUDE	LONGITUDE	SPECIES	# ADULTS
160	39° 34'	74° 16' 30"	GNH	20
			LBH	4
			SNEG	6
			BCNH	12
			GLIB	6
161	39° 33' 30"	74° 16' 30"	GNH	46
			LBH	70
			SNEG	202
			BCNH	6
			GLIB	46
162	39° 35'	74° 15'	GNH	12
			BCNH	10
163	39° 24' 30"	74° 26'	LBH	140
			CATEG	4
			GREG	10
			SNEG	550
			LAH	250
			BCNH	90
			GLIB	110

(continued)

TABLE 57. (continued)

1975 Fixed Wing Heron Survey

COLONY #	LATITUDE	LONGITUDE	SPECIES	# ADULTS
164	39° 25'	74° 26'	GNH	30
			LBH	94
			GREG	16
			SNEG	240
			LAH	106
			BCNH	34
			GLIB	30
165	39° 38' 30"	74° 12'	GNH	4
			LBH	8
			GREG	4
			SNEG	92
			BCNH	34
			GLIB	30

(concluded)

HABITAT: Trees & Shrubs: #'s 155, 156, 157, 158, 163, 164

Shrubs: # 159

Wooded Marsh: #'s 160, 161, 165

Marsh & Shrub: # 162

GNH=Green Heron; LBH=Little Blue Heron; CATEG=Cattle Egret; GREG=Great Egret; SNEG=Snowy Egret; LAH=Louisiana Heron; BCNH=Black-crowned Night Heron; YCNH=Yellow-crowned Night Heron; GLIB=Glossy Ibis

TABLE 58.

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
42a	Atlantic	Absecon Blvd. E.	39° 23'	74° 28'	LT
43	Atlantic	Absecon Blvd. W.	39° 24'	74° 29'	LT
41	Atlantic	Absecon Inlet N.	39° 23'	74° 24'	LT
48	Atlantic	Bass Harbor	39° 19'	74° 35'	LT
38	Atlantic	Bigfish Thoro	39° 21'	74° 26'	GBBG, HG
60 dmi	Atlantic	Black Pt.	37° 26'	74° 24'	SNEG, GLIB
39	Atlantic	Brigantine Blvd.	39° 23'	74° 24'	BCNH, YCNH, GLIB
35	Atlantic	Brigantine Channel E.	39° 27'	74° 22'	LG,GBT,CT, SK
36	Atlantic	Brigantine Channel W.	39° 26'	74° 23'	LG, GBT, CT
49	Atlantic	Drag Is.	39° 18'	74° 37'	LT
33	Atlantic	Great Thorofare	39° 29'	74° 21'	LG
38	Atlantic	Gull Is. Thoro [Little Gull Is.]	39° 25'	74° 26'	GBBG, HG, LBH, CATEG, GREG, SNEG, LAH, BCNH, GLIB
34	Atlantic	Hammock Cove Is.	39° 27'	74° 24'	HG, BCNH
47	Atlantic	Hospitality Creek	39° 18'	74° 34'	GBBG, HG, LG, CT, LT

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
A61b dmi	Atlantic	Islajo	39° 25'	74° 25'	GNH, LBH. CATEG, GREG, SNEG, LAH, BCNH, GLIB
31	Atlantic	Little Beach Is.	39° 28'	74° 19'	GREG, GLIB
29	Atlantic	Little Beach Is. N.	39° 30'	74° 20'	CT, SK
32	Atlantic	Little Beach Is. S.	39° 28'	74° 19'	GREG, SNEG, BCNH, GLIB
A61c dmi	Atlantic	Little Heron Is.	39° 24'	74° 26'	LBH, CATEG, GREG, SNEG, BCNH
47a	Atlantic	Longport Sod Banks	39° 19'	74° 33'	LT
40	Atlantic	Peter Beach	39° 23'	74° 24'	LT
46	Atlantic	Pork Is.	39° 20'	74° 31'	LBH, GREG, SNEG, BCNH, YCNH, LG, CT
37	Atlantic	Somers Bay	39° 26'	74° 23'	GBBG, HG, LG, FT, CT
42	Atlantic	Stake Thoro	39° 23'	74° 25'	SNEG, BCNH, GLIB
44	Atlantic	Ventnor City Beach	39° 21'	74° 30'	LT
45	Atlantic	Whirlpool Is.	39° 21'	74° 31'	LG
65	Cape May	Anglesea Is.	39° 01'	74° 49'	LG

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
59	Cape May	Avalon Causeway	39° 07'	74° 44'	CT, LT, SK
53	Cape May	Burroughs Hole	39° 11'	74° 41'	LG
73	Cape May	Cape May Ferry Slip	38° 58'	74° 58'	CT, LT
71	Cape May	Cape May Inlet	38° 57'	74° 52'	GNH, LBH, CATEG, GREG, SNEG, BCNH, YCNH, GLIB
58	Cape May	*Cornell Harbor*	39° 07'	74° 43'	LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB
50	Cape May	Corson's Inlet N.	39° 13'	74° 39'	LT
A80a dmi	Cape May	Cowpens Is.	39° 17'	74° 35'	LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB
65a	Cape May	Dead Thorofare	39° 02'	74° 40'	FT
52	Cape May	Flat Creek	39° 12'	74° 41'	FT
62	Cape May	Great Flat Thoro	39° 03'	74° 48'	GBBG, HG, LG
60	Cape May	Muddy Hole	39° 04'	74° 46'	LG, CT
103 dmi	Cape May	Nummy's Is.	39° 02'	74° 48'	GBBG, HG, LG

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
61	Cape May	Ring Is.	39° 03'	74° 47'	LG
64	Cape May	Seven Mile Beach	39° 02'	74° 46'	LT
66	Cape May	Shaw Cutoff	38° 59'	74° 51'	GBH, LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB
72	Cape May	South Cape May	38° 50'	74° 56'	CT, LT
57	Cape May	South Channel	39° 07'	74° 44'	CT
69	Cape May	S. W. Cove Pt.	38° 58'	74° 52'	CT, SK
67	Cape May	Stingaree Pt.	38° 59'	74° 51'	GBH, LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB
51 [86 dmi]	Cape May	Strathmere Bay	39° 12'	74° 39'	LG, FT, SK
63	Cape May	Stone Harbor	39° 02'	74° 46'	GNH, LBH, CATEG, GREG, SNEG, LAH, BCNH, YCNH, GLIB
68	Cape May	Swain Channel	38° 59'	74° 57'	LG, FT, SK
55	Cape May	Townsend's Inlet	39° 08'	74° 43'	GREG, SNEG, LAH, BCNH, GLIB
56	Cape May	Townsend's Inlet	39° 07'	74° 43'	GBT

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
70	Cape May	Two Mile Beach I	38° 57'	74° 51'	LT
70	Cape May	Two Mile Beach II	38° 57'	74° 51'	LT
85	Cape May	Weakfish Creek	39° 93'	74° 39'	GREG, SNEG, GLIB, BCNH
54	Cape May	Whale Beach	39° 10'	74° 41'	LT
7	Ocean	Barnegat	39° 46'	74° 07'	LBH, GREG, SNEG, LAH, BCNH
8	Ocean	Barnegat Inlet	39° 46'	74° 06'	LT
5	Ocean	large Buster Is.	39° 48'	74° 06'	CT
5	Ocean	mid Buster Is.	39° 48'	74° 07'	CT
5	Ocean	side Buster Is.	39° 48'	74° 07'	CT
5	Ocean	small Buster Is.	39° 48'	74° 07'	CT
5	Ocean	W. Buster Is.	39° 48'	74° 06'	CT
14	Ocean	Carvel Is. E.	39° 41'	74° 10'	CT, SK
14	Ocean	Carvel Is. W.	39° 41'	74° 10'	HG, CT, SK
17	Ocean	Cedar Creek Is.	39° 40'	74° 13'	CT, SK

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
18	Ocean	Cedar Bonnet S.	39° 39'	74° 12'	CT
18	Ocean	Cedar Bonnet S. E.	39° 39'	74° 12'	HG, CT
18	Ocean	Cedar Bonnet S. W.	39° 39'	74° 12'	HG, CT, SK
18	Ocean	Cedar Bonnet W.	39° 39'	74° 12'	CT
1	Ocean	Chadwick	40° 00'	74° 05'	CT
9	Ocean	Clam Bar S.	39° 45'	74° 08'	LG, FT
9	Ocean	Clam Is.	39° 46'	74° 08'	GBBG, HG, LG
9	Ocean	Clam Is. E.	39° 46'	74° 08'	LG, CT
19	Ocean	Egg Is.	39° 38'	74° 13'	HG, CT
13	Ocean	Flat Creek	39° 42'	74° 11'	CT
40 dmi	Ocean	Flat Is.	39° 38'	74° 12'	LBH, GREG, SNEG, BCNH, GLIB
27	Ocean	Goosebar Sedge	39° 32'	74° 17'	HG, LBH
A43a dmi	Ocean	Ham Is.	39° 36'	74° 13'	HG, CT
26	Ocean	Hester Sedge	39° 34'	74° 18'	CT
20	Ocean	High Is.	39° 37'	74° 12'	LBH

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
28	Ocean	Holgate	39° 31'	74° 17'	CT, LT, SK
6	Ocean	Island Beach	39° 48'	74° 06'	CT
3	Ocean	Lavelette S.	39° 59'	74° 07'	CT
3	Ocean	Lavelette S. W.	39° 59'	74° 05'	CT
22	Ocean	Little Is.	39° 35'	74° 15'	CT
11a	Ocean	Little Beach Is.	39° 44'	74° 10'	CT
15	Ocean	Log Creek	39° 41'	74° 11'	CT
15	Ocean	Log Creek W.	39° 41'	74° 11'	CT
21	Ocean	Long Point E.	39° 36'	74° 16'	CT
21	Ocean	Long Point W.	39° 36'	74° 16'	CT
25	Ocean	Middle Is.	39° 34'	74° 17'	GBBG, HG, LG
1	Ocean	Middle Sedge	40° 00'	74° 05'	CT
24	Ocean	Middle Sedge	39° 34'	74° 17'	HG, LG, CT
23	Ocean	Mordecai Is.	39° 34'	74° 15'	CT

(continued)

TABLE 58. (continued)

1976 Coastal Nest Sites

SITE #	COUNTY	NAME	LATITUDE	LONGITUDE	SPECIES PRESENT
2	Ocean	N. W. Pt.	39° 60'	74° 05'	HG, CT
4	Ocean	Pelican Is.	39° 57'	74° 05'	CT, LT
16	Ocean	Pettit Is.	39° 40'	74° 11'	HG, CT
12	Ocean	Sandy Is.	39° 43'	74° 09'	HG, CT
11	Ocean	Sloop Sedge E.	39° 44'	74° 09'	HG, CT
11	Ocean	Sloop Sedge W.	39° 44'	74° 09'	HG, CT, SK
10	Ocean	Vol Sedge E.	39° 45'	74° 08'	CT
10	Ocean	Vol Sedge W.	39° 45'	74° 08'	CT

(concluded)

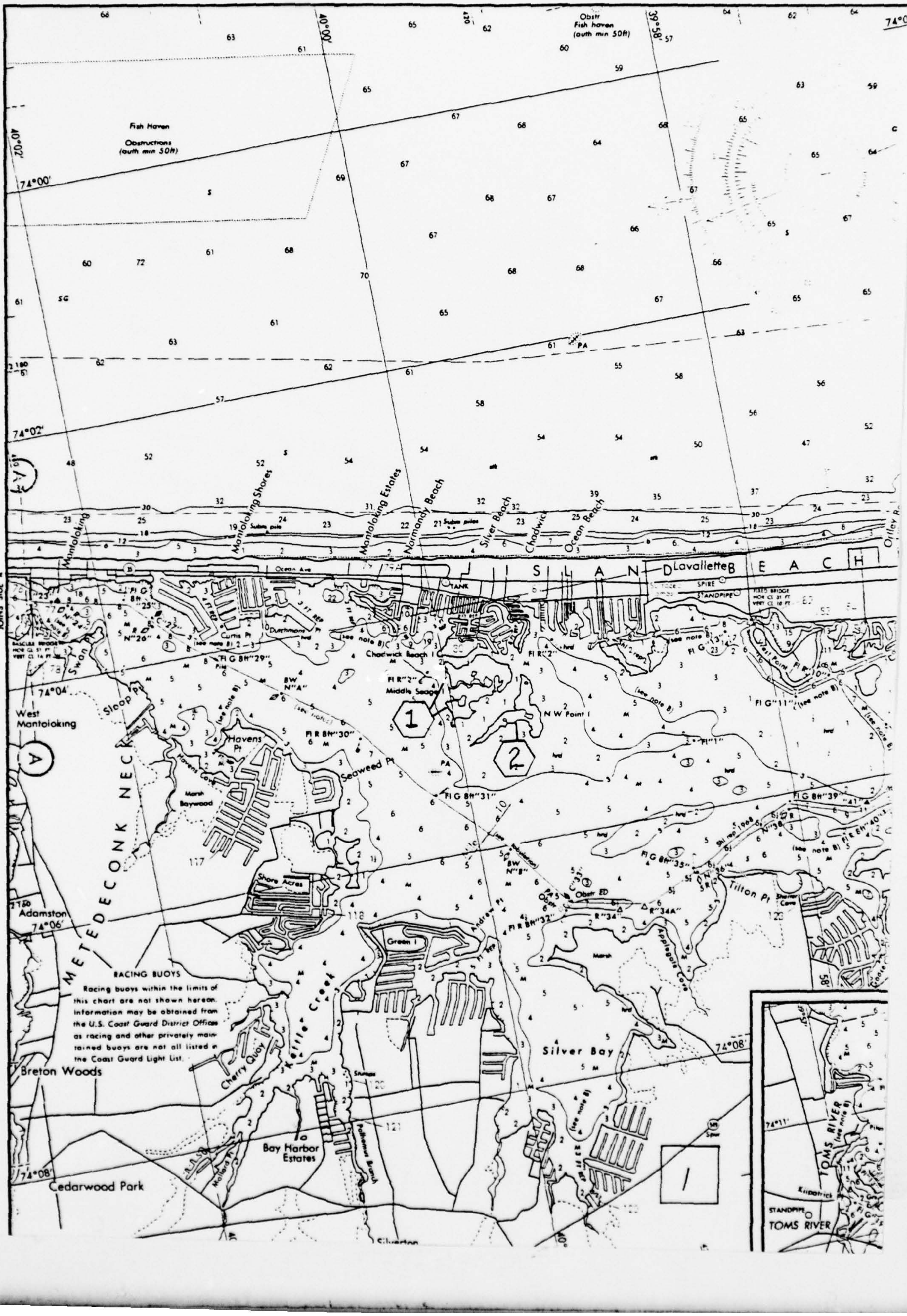
dmi= dredged material island

GBH=Great Blue Heron; GNH=Green Heron; LBH=Little Blue Heron; CATEG=Cattle Egret; GREG=Great Egret; SNEG=Snowy Egret; LAH=Louisiana Heron; BCNH=Black-crowned Night Heron; YCNH=Yellow-crowned Night Heron; GLIB=Glossy Ibis; GBBG=Great Black-backed Gull; HG=Herring Gull; LG=Laughing Gull; GBT=Gull-billed Tern; FT=Forster's Tern; CT=Common Tern; RT=Roseate Tern; LT=Least Tern; SK=Black Skimmer

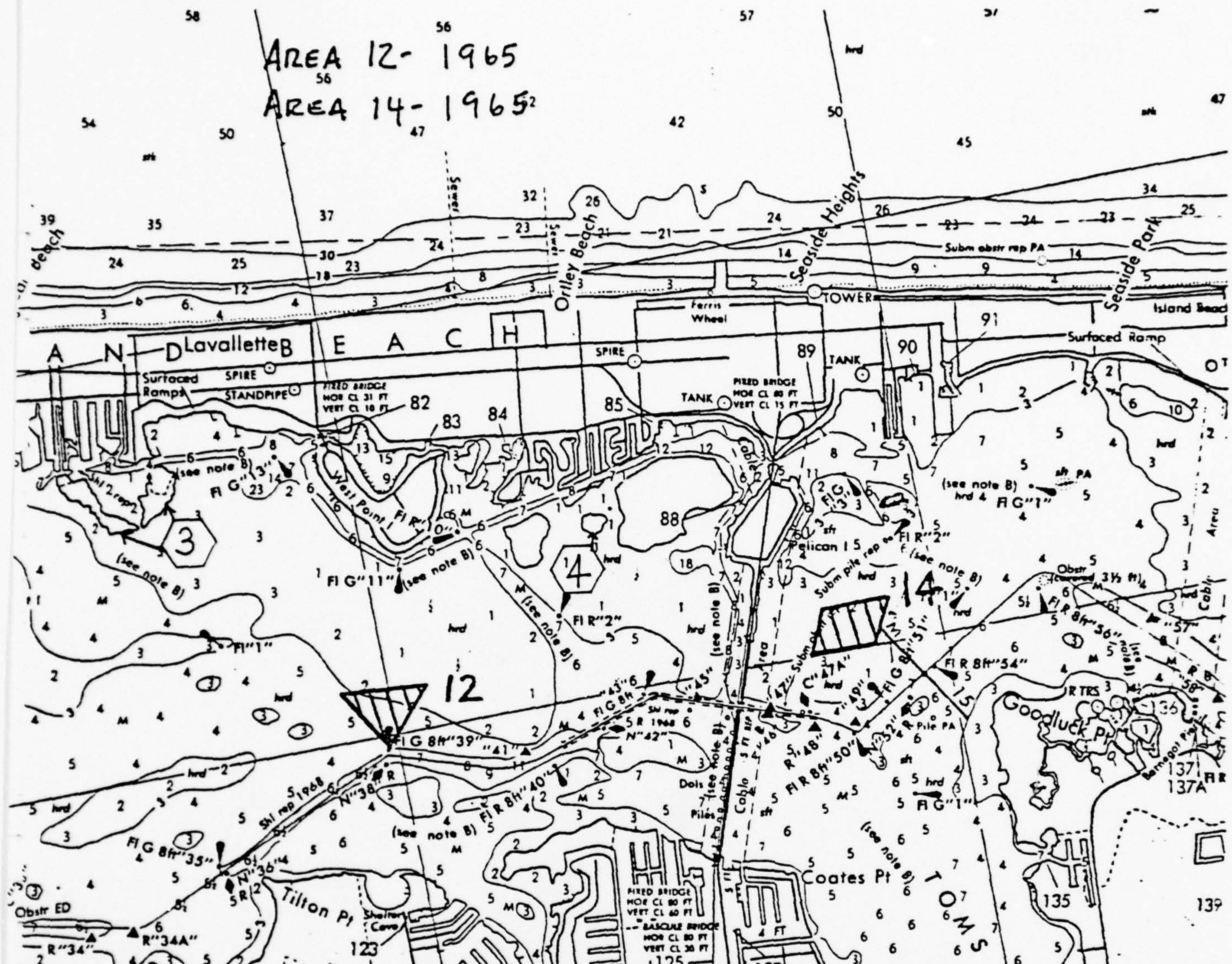
FIGURE 2.   1976 Coastal Nest Sites

denotes bird nesting areas

SIDE B



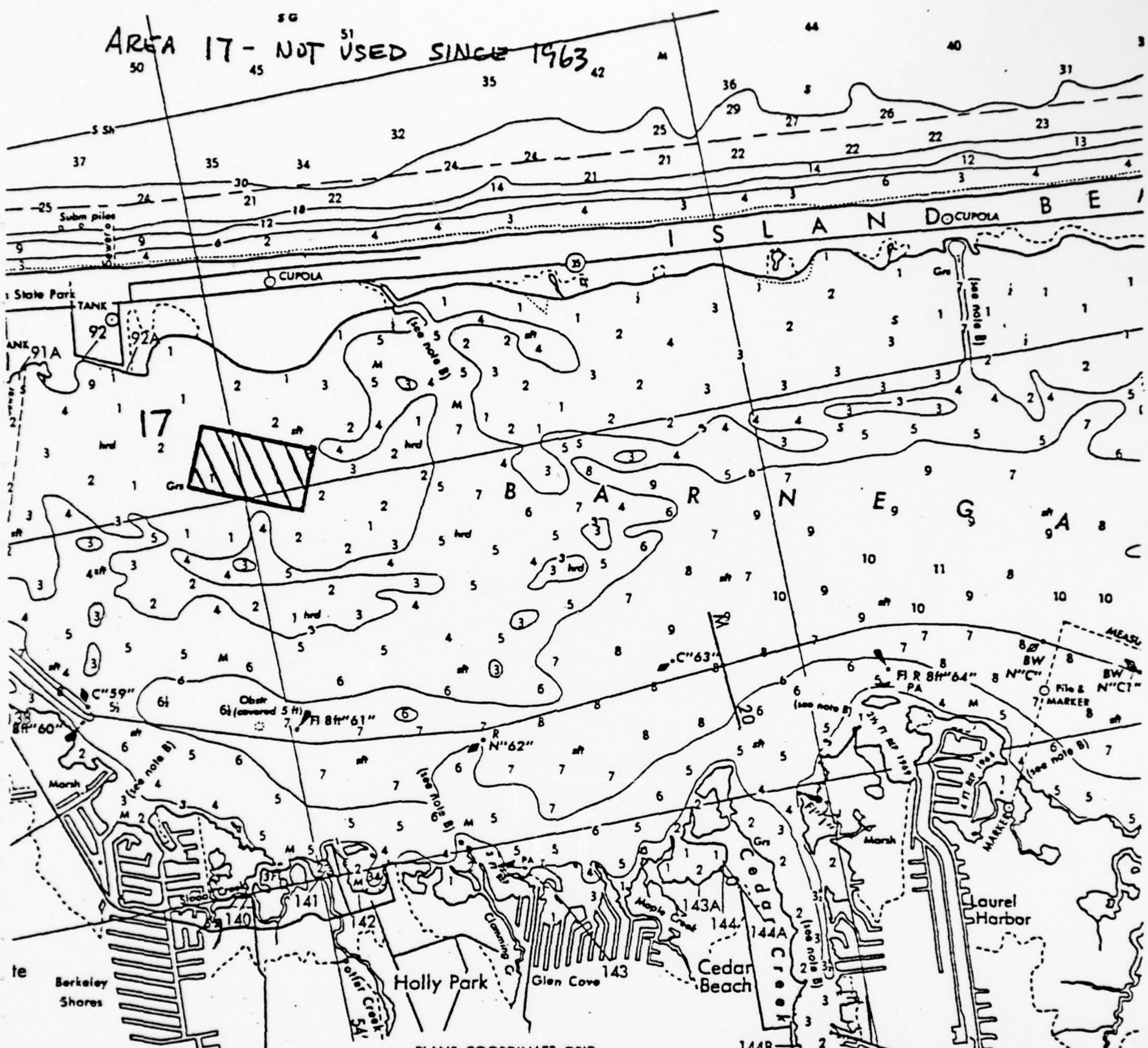
Fish Haven
Obstructions (auth min 50ft)
Obstr Fish haven (auth min 50ft)
74°00'
74°02'
74°04'
74°06'
74°08'
40°00'
39°58'
JOINS SIDE A
Mantoloking
Mantoloking Shores
Mantoloking Estates
Normandy Beach
Silver Beach
Chadwick
Ocean Beach
Lavallette
ISLAND BEACH
Ocean Ave
TANK
SPIRE
STANDPIPE
Curtis Pt
Dutchmans Pt
Chadwick Beach I
Middle Sedge I
N W Point I
West Point I
Swan Pt
Sloop Pt
West Mantoloking
Havens Pt
Havens Cove
Marsh
Baywood
Seaweed Pt
Shore Acres
Adamston
METEDECONK NECK
Green I
Andrew Pt
Applegate Cove
Tilton Pt
Shelter Cove
Silver Bay
Kettle Creek
Cherry Quay
Mallard Pt
Bay Harbor Estates
Breton Woods
Cedarwood Park
Silverton
Toms River
TOMS RIVER
Kilpatrick
STANDPIPE
RACING BUOYS
Racing buoys within the limits of this chart are not shown hereon. Information may be obtained from the U.S. Coast Guard District Offices as racing and other privately maintained buoys are not all listed in the Coast Guard Light List.
1
2
A



SHEET 1A

CONTINUED ON TOMS RIVER EXTENSION

AREA 17 - NOT USED SINCE 1963



STORM WARNING DISPLAYS

Storm warning signals are displayed from masts of Police Patrol Boats while underway along the New Jersey coast and the Inland Waterway.

NOTE B

Channel is marked by privately maintained seasonal buoys or markers.

AIDS TO NAVIGATION

Consult U.S. Coast Guard Light List for supplemental information concerning aids to navigation.

PLANE COORDINATE GRID

New Jersey State Grid is indicated by dashed ticks at 10,000 foot intervals. The last 3 digits of the grid values have been omitted.

CAUTION

Temporary changes or defects in aids to navigation are not indicated on this chart. See Notice to Mariners.

During some winter months or when endangered by ice, certain aids to navigation are replaced by other types or removed. For details see Coast Guard Light List.

SCALE 1:40,000

NAUTICAL MILES

1 0 1 2

STATUTE MILES

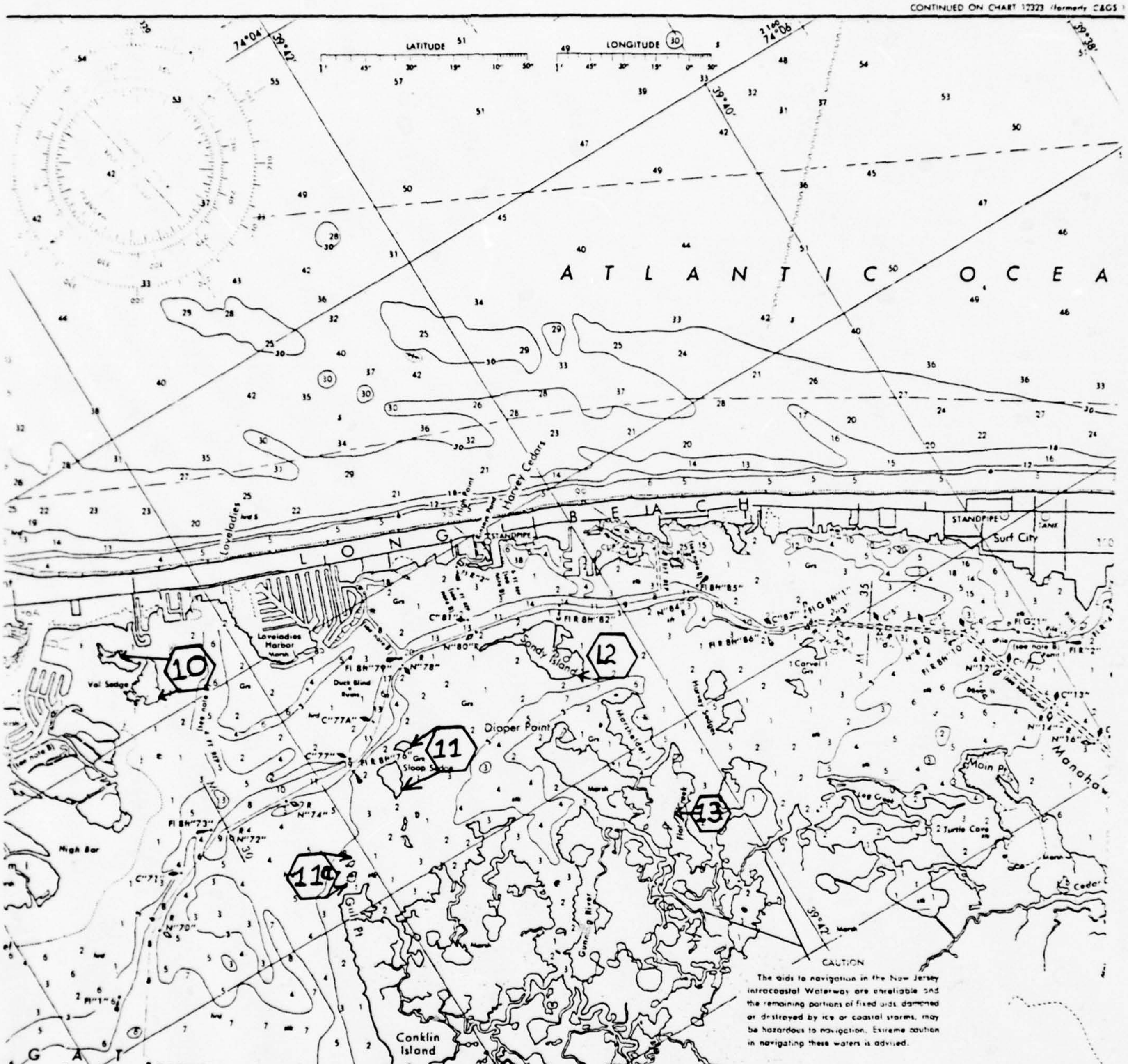
1 0 1 2

YARDS

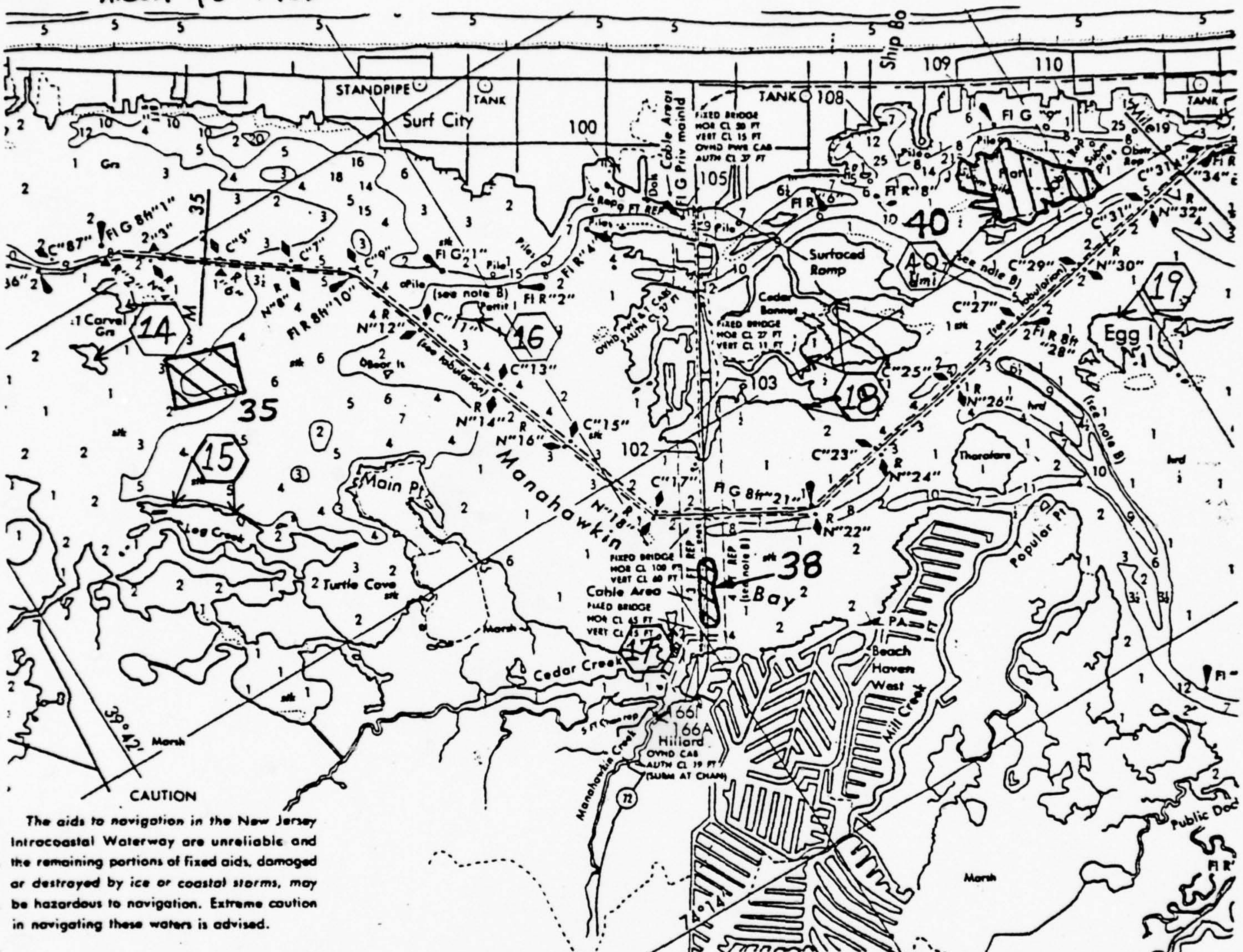
1000 0 1000 2000 3000

SHEET 2

AREA 25 · 1970
Barnegat Light
LOOKOUT TOWER
TOWER (Abandoned Lt Ho)
C G
R Bn 322 kHz
TANK
Marsh
Sedge Islands
Oyster Creek Channel
USE PANEL AT RIGHT
25
Clam I
High Bar
74°08'
74°10'
74°12'
Fl "2"
BW N "D1"
(see tabulation)
BW N "E"13
BW N "E1" 22
R N "40"
Fl 2½ sec "39"
Mile 25
9N "56"
Fl R "2"
W Or "J"
Fl 4 sec Priv maintd
Fl "3"
Fl R "12"
Shoal rep
Sands Point Harbor
Oyster Creek
Being Filled
Forked River
Fl R "20"
North Branch
Middle Br
South Branch
BW N "G"
(see notes)
Fl R 8ft "68"
Fl "1"
Fl R "2"
Platforms
Fl G "1"
Stakes
Rks
Barnegat Beach
Waretown
Waretown Creek
Sonborn Anchorage
155
156
157
158
158A
159
160
161
162
154
154A
154B
153
152A
152
STACK 391 ft
C RR OF NJ
Waretown Jct
TANK
Lochiel Creek
Pebble Beach
39°48'
39°46'
SHEET 3


CONTINUED ON CHART 12323 (formerly C&GS)
LATITUDE
LONGITUDE
ATLANTIC OCEA
LONG BEACH
Loveladies
Harvey Cedars
STANDPIPE
Surf City
Loveladies Harbor
Vol Sedge
Sandy Island
Duck Blind
Dipper Point
Sloop Sedge
High Bar
Manahawkin
Conklin Island
Gunning River
Barnegat Beach
Pebble Beach
Barnegat
Marsh
10
11
11a
12
13
CAUTION
The aids to navigation in the New Jersey intracoastal Waterway are unreliable and the remaining portions of fixed aids damaged or destroyed by ice or coastal storms, may be hazardous to navigation. Extreme caution in navigating these waters is advised.
NOTE B
Channel is marked by privately maintained seasonal buoys or markers.
NOTE C
Barnegat Inlet
Oyster Creek Channel
The channels are subject to continual change. Buoys are not charted because they are frequently shifted in position.
TIDAL INFORMATI
While the normal range of t
about ½ foot in Barnegat Ba
winds of long duration. the ch
may amount to a maximum o
above or below the norma
water respectively. Near the
has a lesser effect and the ne
the tide is about 3 feet.
AIDS TO NAVIGATION
The aids to navigation marking the intracoastal Waterway are maintained by the U.S. Coast Guard.
The aids marking tributary channels, in general, are maintained by the state of New Jersey.
All lights and lighted buoys marking the Intracoastal Waterway on this chart show a flash every 4 seconds.
Reflectors on daybeacons and buoys along the Intracoastal Waterway are green on the left hand and red on the right-hand side when proceeding southward.
3A
SCALE 1:40,0
NAUTICAL MIL
STATUTE MIL
YARDS
LOGARITHMIC SPEE
To find SPEED, place one point of dividers on nautical miles run and the right point on 60 and left point will then indicate speed in knots. Example

AREA 35 - 1965
AREA 38 - 1965
AREA 40 - 1965



CAUTION

The aids to navigation in the New Jersey Intracoastal Waterway are unreliable and the remaining portions of fixed aids, damaged or destroyed by ice or coastal storms, may be hazardous to navigation. Extreme caution in navigating these waters is advised.

NOTE B

Channel is marked by privately maintained seasonal buoys or markers.

NOTE C

Barnegat Inlet
Oyster Creek Channel

The channels are subject to continual change. Buoys are not charted because they are frequently shifted in position.

TIDAL INFORMATION

While the normal range of the tide is only about ½ foot in Barnegat Bay, with strong winds of long duration, the change in depth may amount to a maximum of about 3 feet above or below the normal high or low water respectively. Near the inlets the wind has a lesser effect and the normal range of the tide is about 3 feet.

FISH TRAP AREAS

Boundary lines of fish trap areas are shown thus: — — — — —

Caution: Submerged piling may exist in these areas.

CAUTION

Mariners are warned to stay clear of the protective riprap surrounding navigational light structures shown thus:

SCALE 1:40,000

NAUTICAL MILES 1 ½ 0 1 2

STATUTE MILES 1 ½ 0 1 2

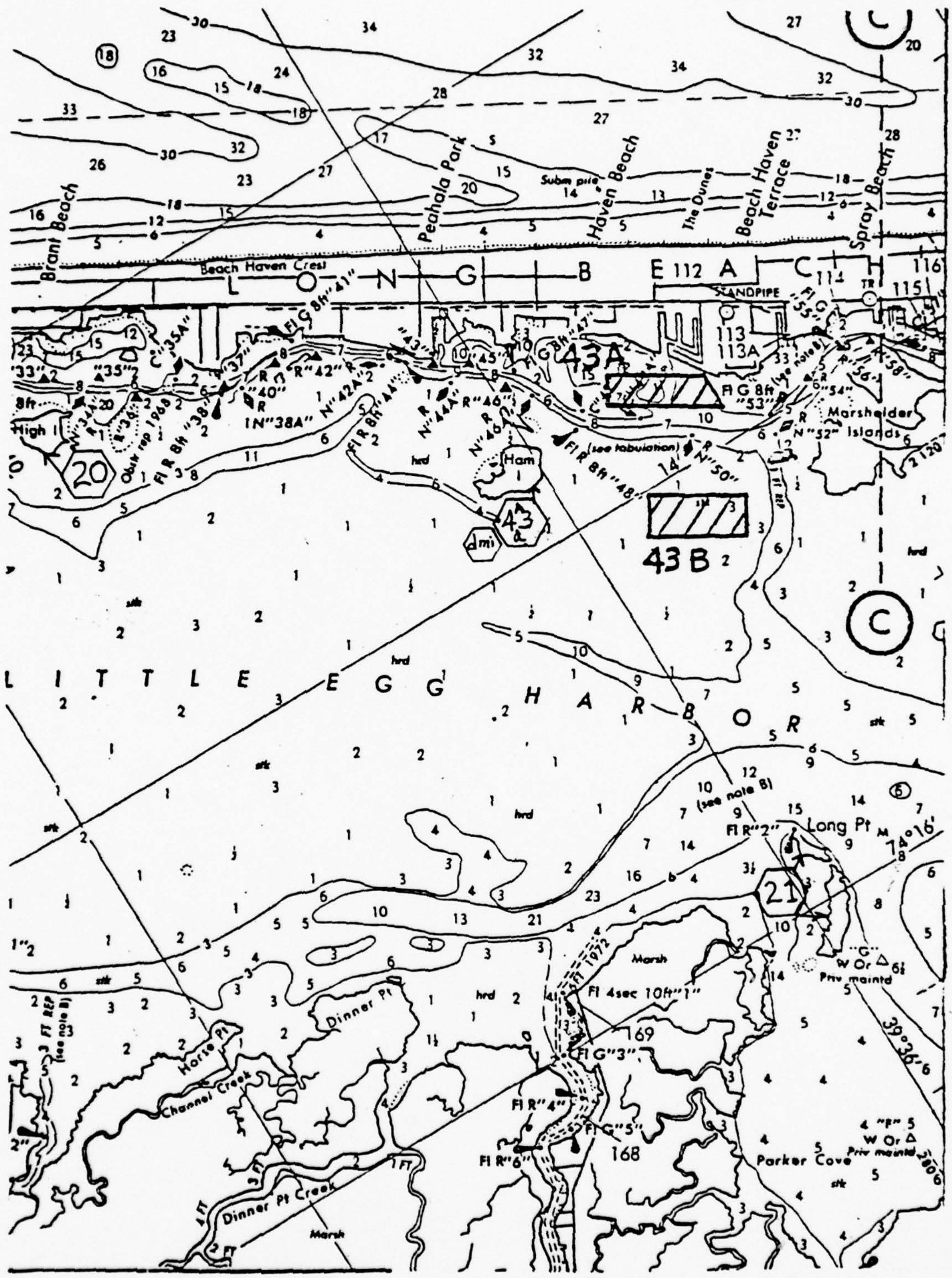
YARDS 1000 0 1000 2000 3000

LOGARITHMIC SPEED SCALE

1 2 3 4 5 6 7 8 9 10 15 20 25 30 40 50 60

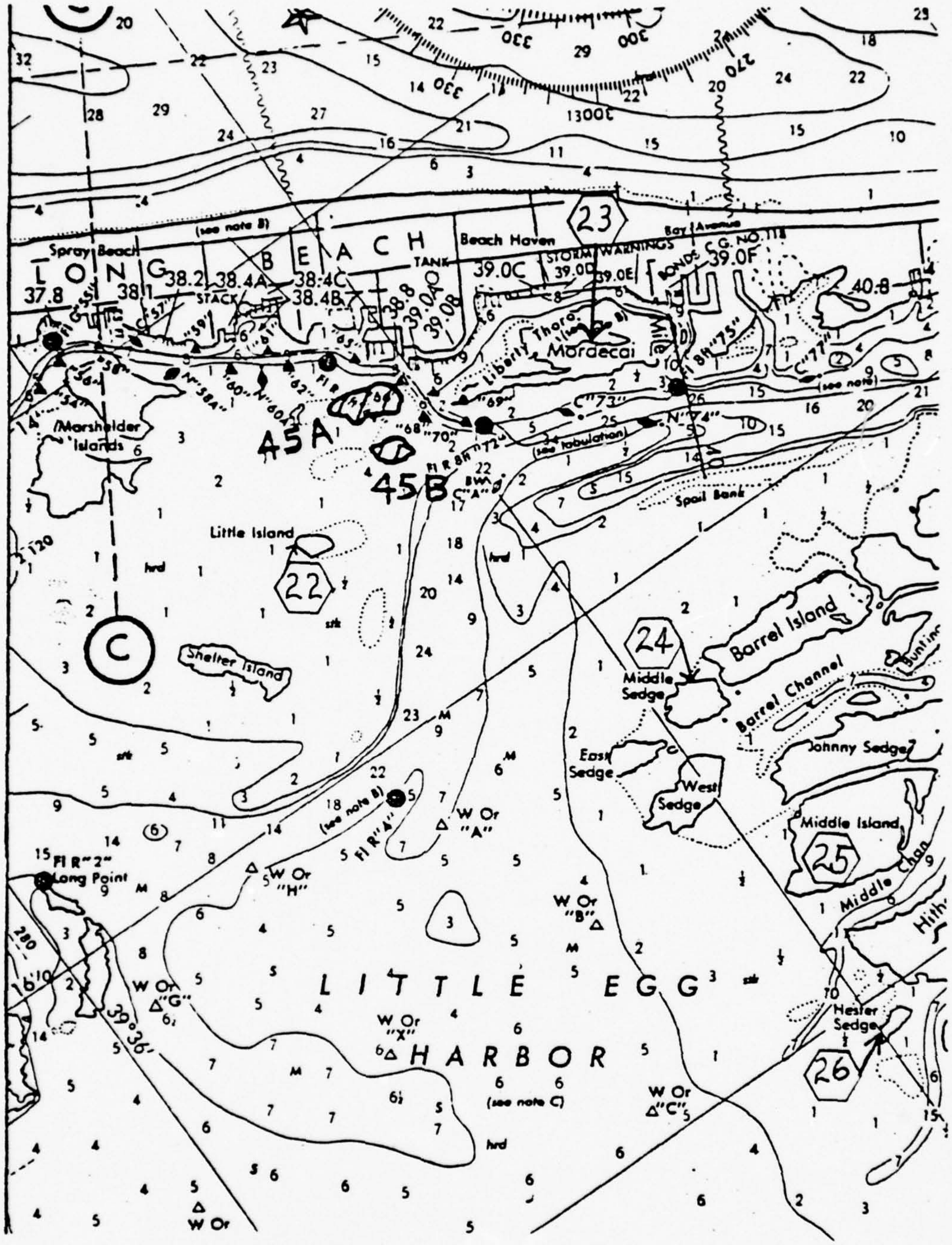
To find SPEED, place one point of dividers on nautical miles run and the other on minutes run. Without changing divider spread, place right point on 60 and left point will then indicate speed in knots. Example: with 4.0 miles run in 15 minutes, the speed is 16.0 knots.

SHEET 4



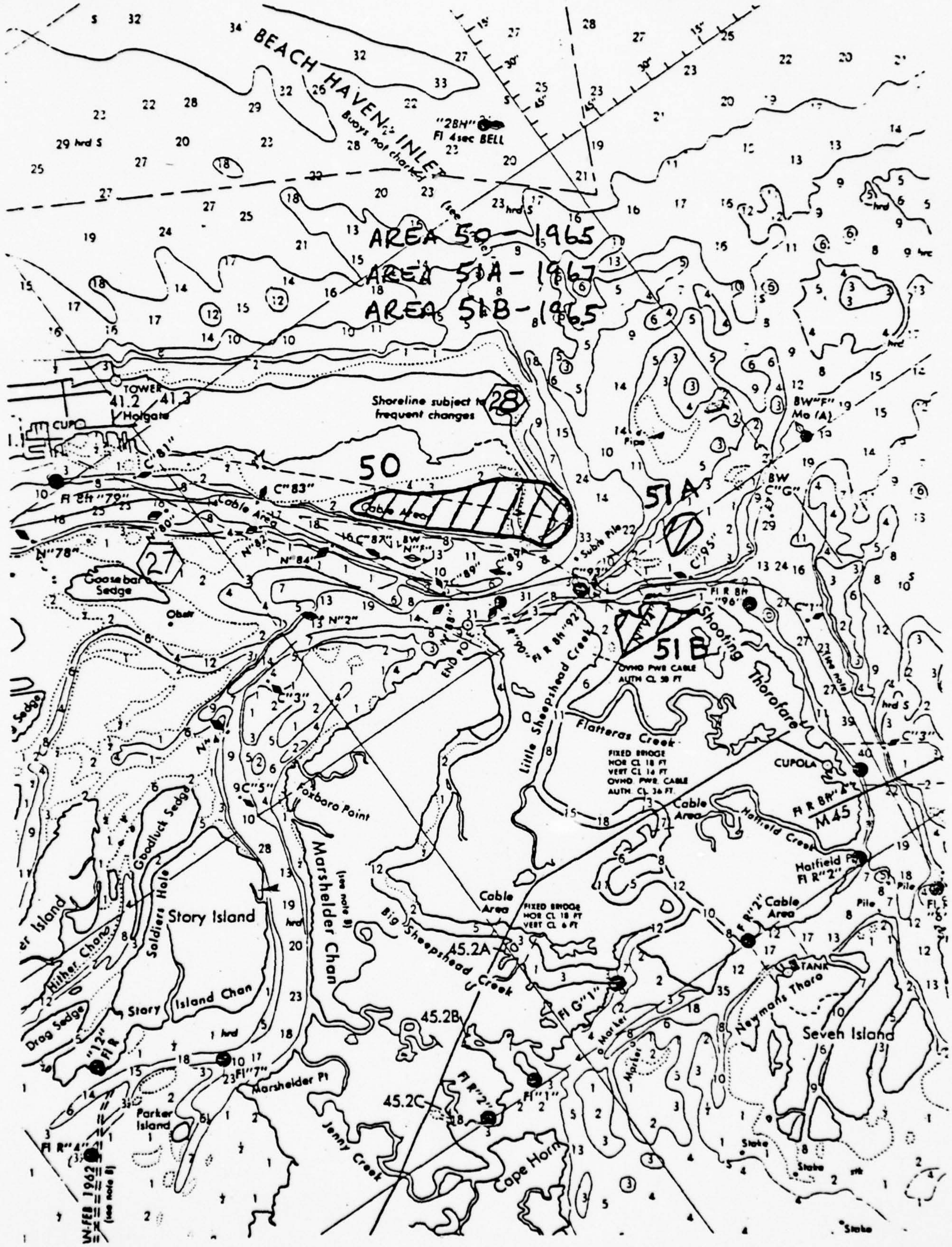
AREA 43A - 1965
AREA 43B - NOT USED SINCE 1963

SHEET 5

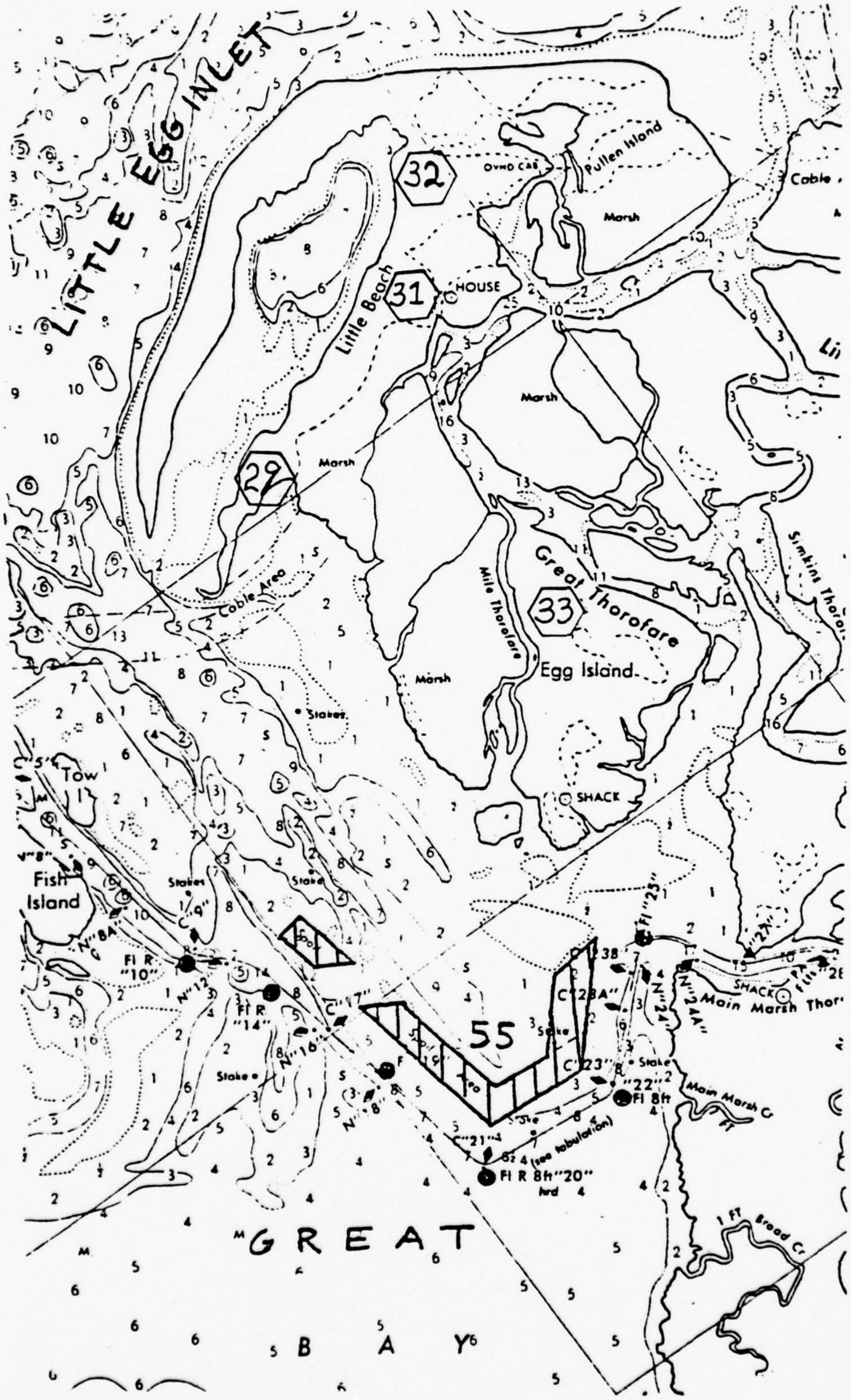


AREA 45A - 1963, 1966, 1967, 1976
AREA 45B - 1963

SHEET 6


BEACH HAVEN INLET
Buoys not charted
"28H"
Fl 4sec BELL
AREA 50 - 1965
AREA 51A - 1967
AREA 51B - 1965
Shoreline subject to frequent changes
TOWER
Holgate
CUPOLA
50
Cable Area
51A
51B
Subm Pile
Goosebar Sedge
OVHD PWR CABLE AUTH CL 50 FT
Shooting Thorofare
Little Sheepshead Creek
Flatteras Creek
FIXED BRIDGE HOR CL 18 FT VERT CL 16 FT OVHD PWR CABLE AUTH CL 36 FT
CUPOLA
Cable Area
Hatfield Creek
M45
Foxboro Point
Marshelder Chan
Goodluck Sedge
Soldiers Hole
Story Island
Hither Chan
Story Island Chan
Drag Sedge
Big Sheepshead Creek
45.2A
45.2B
45.2C
Cable Area
FIXED BRIDGE HOR CL 18 FT VERT CL 6 FT
Hatfield Pt
Newmans Thoro
Seven Island
TANK
Marshelder Pt
Parker Island
Jenny Creek
Cape Horn
41.2
41.3

SHEET 7



AREA 55 - 1963, 1967, 1970, 1972, 1973, 1974, 1975, 1976

SHEET 8

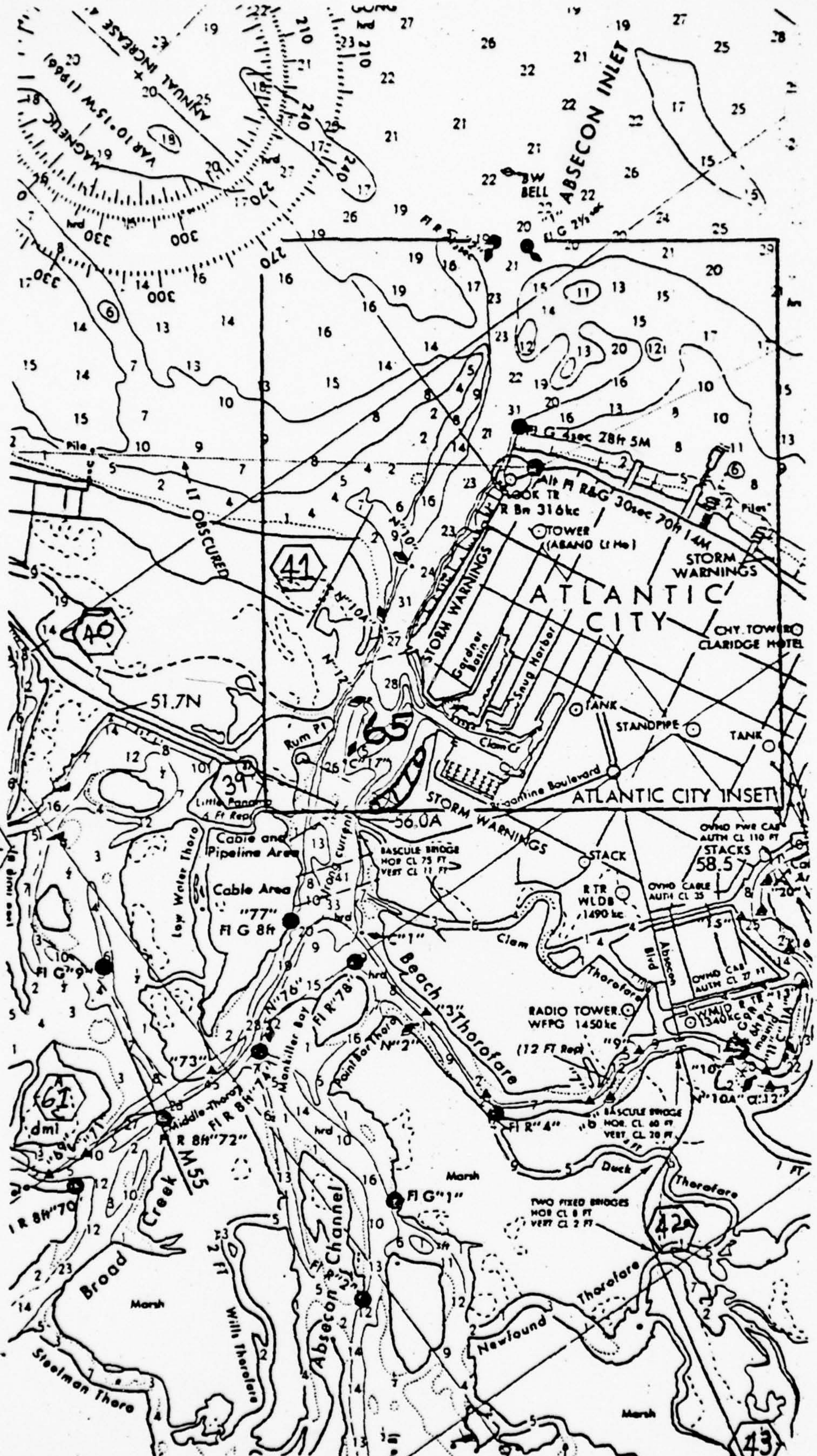
AREA 58- 1963, 1967, 1969, 1973, 1975

AREA 59- 1968

AREA 60- 1963, 1966, 1967
1969, 1972, 1975,
1976

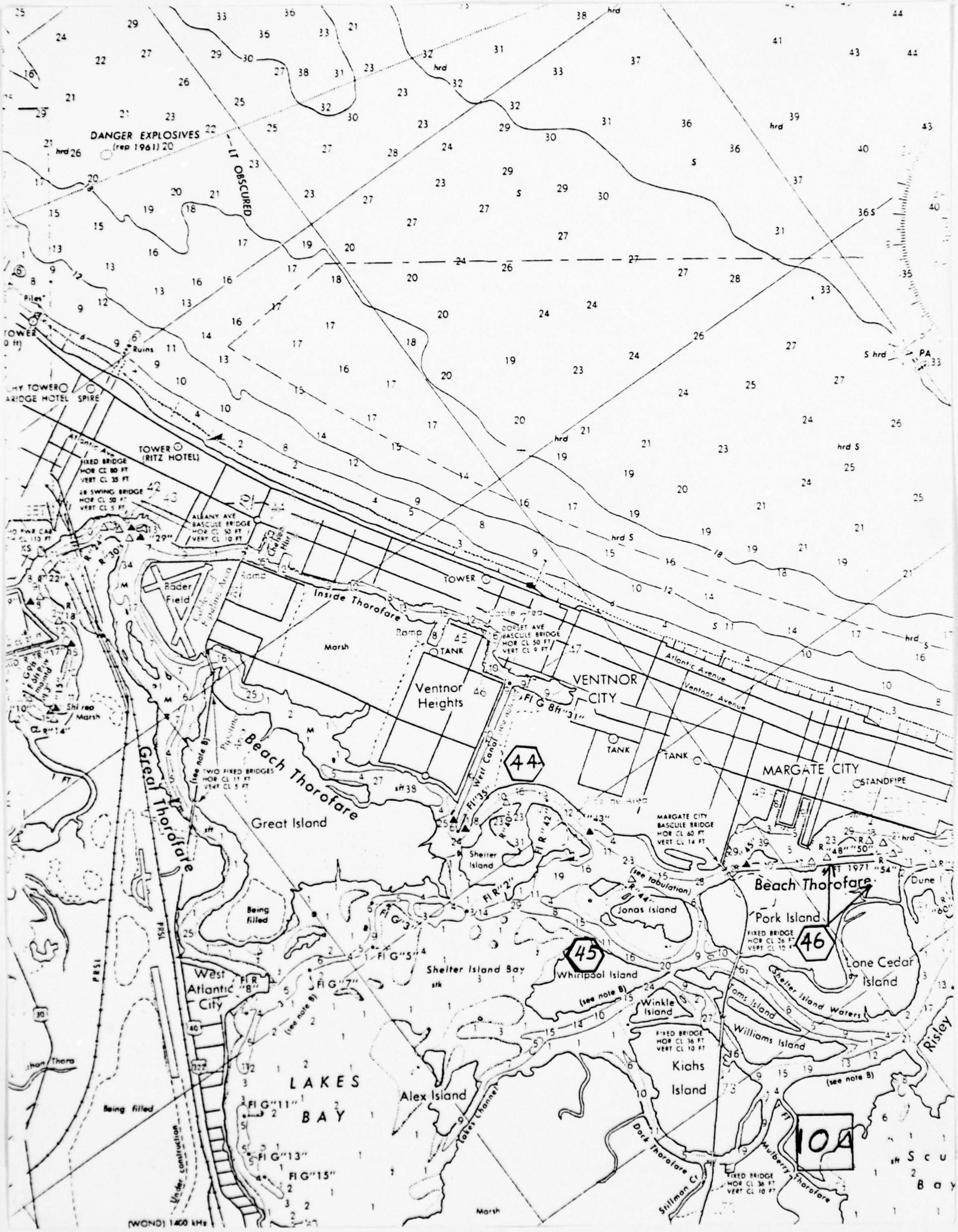
SHEET 9

AREA 61- 1963, 1965, 1967



AREA 65- 1969

SHEET 10


DANGER EXPLOSIVES
(rep 1961)
LT OBSCURED
TOWER
Ruins
BRIDGE HOTEL
SPIRE
TOWER
(RITZ HOTEL)
Atlantic Ave
FIXED BRIDGE
HOR CL 80 FT
VERT CL 35 FT
SWING BRIDGE
HOR CL 50 FT
VERT CL 5 FT
ALBANY AVE
BASCULE BRIDGE
HOR CL 50 FT
VERT CL 10 FT
Bader Field
Inside Thorofare
TOWER
Ramp
TANK
Marsh
DORSET AVE
BASCULE BRIDGE
HOR CL 50 FT
VERT CL 9 FT
Ventnor Heights
VENTNOR CITY
Atlantic Avenue
Ventnor Avenue
Fl G 8ft "31"
Beach Thorofare
Great Thorofare
TWO FIXED BRIDGES
HOR CL 11 FT
VERT CL 5 FT
(see note B)
West Canal
TANK
TANK
MARGATE CITY
STANDPIPE
Great Island
MARGATE CITY
BASCULE BRIDGE
HOR CL 60 FT
VERT CL 14 FT
Shelter Island
Fl R "2"
(see tabulation)
Jonas Island
Beach Thorofare
Pork Island
FIXED BRIDGE
HOR CL 36 FT
VERT CL 10 FT
Being filled
Fl G "3"
Fl G "5"
Fl G "7"
Fl R "8"
West Atlantic City
Shelter Island Bay
Whirlpool Island
Winkle Island
Toms Island
Shelter Island Waters
Lone Cedar Island
Williams Island
Risley
FIXED BRIDGE
HOR CL 36 FT
VERT CL 10 FT
Kiahs Island
(see note B)
LAKES BAY
Alex Island
Fl G "11"
Fl G "13"
Fl G "15"
Being filled
Under construction
Lakes Channel
Dock Thorofare
Stillman Cr
Mulberry Thorofare
FIXED BRIDGE
HOR CL 36 FT
VERT CL 10 FT
Marsh
(WOND) 1400 kHz
10A
Scull Bay
44
45
46

AREA 77-1964

AREA 78A-1963, 1965, 1966

AREA 78B-1963, 1964, 1966, 1967, 1969

AREA 78C-1971, 1972, 1973, 1974, 1975, 1976

SHEET 11

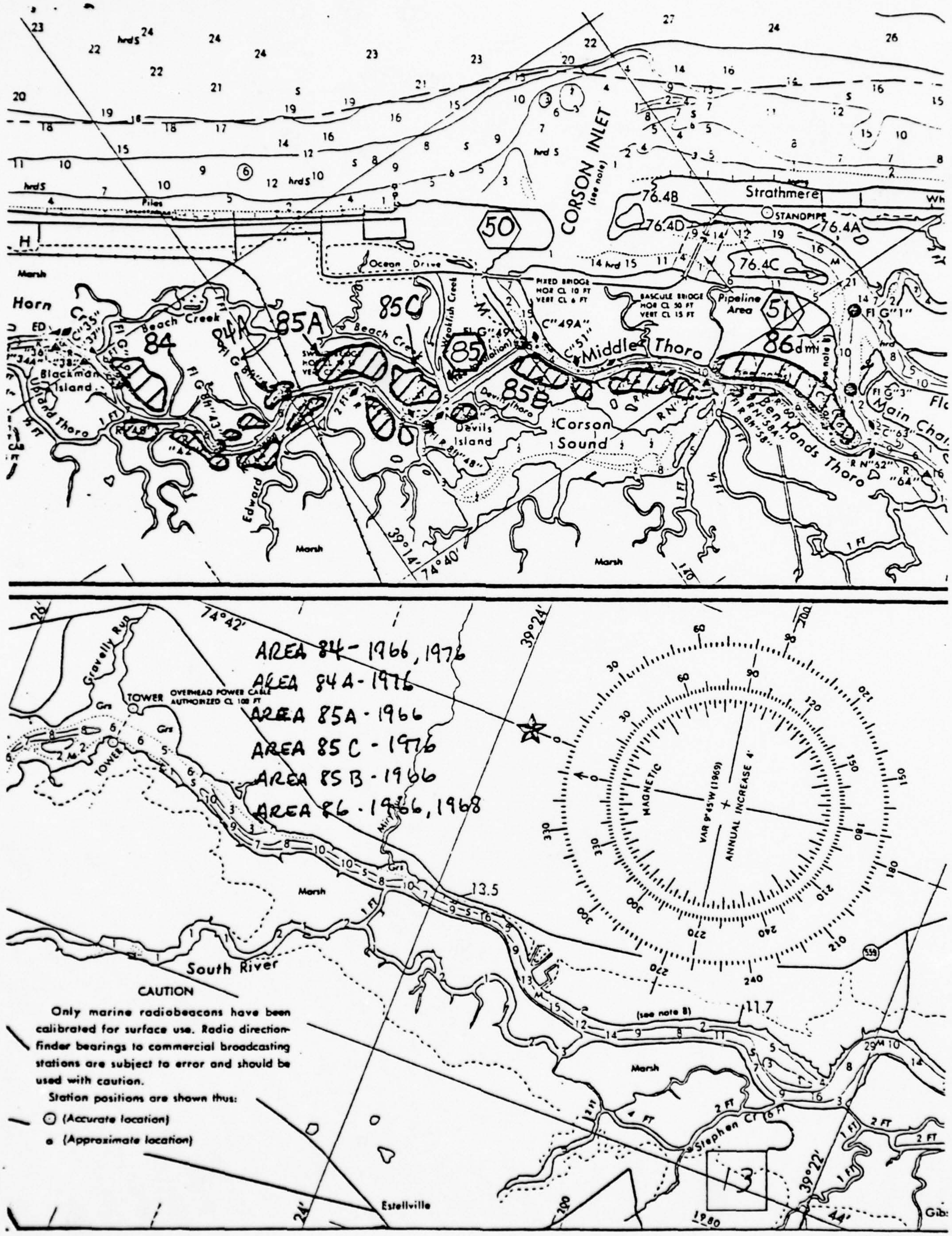
AREA 80 - 1972

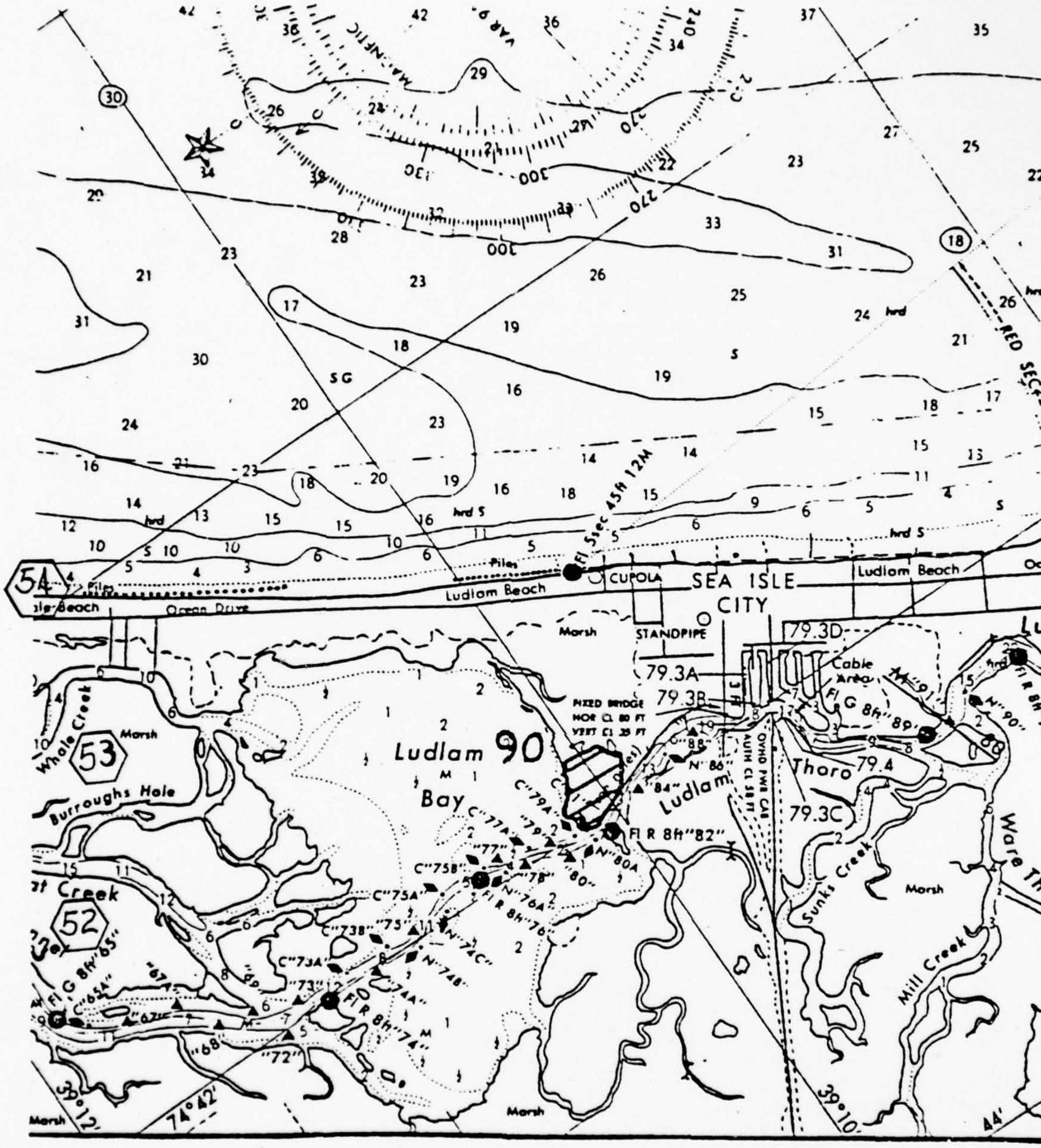
AREA 82 - 1969

AREA 82A - 1974

AREA 83 - 1964

SHEET 12

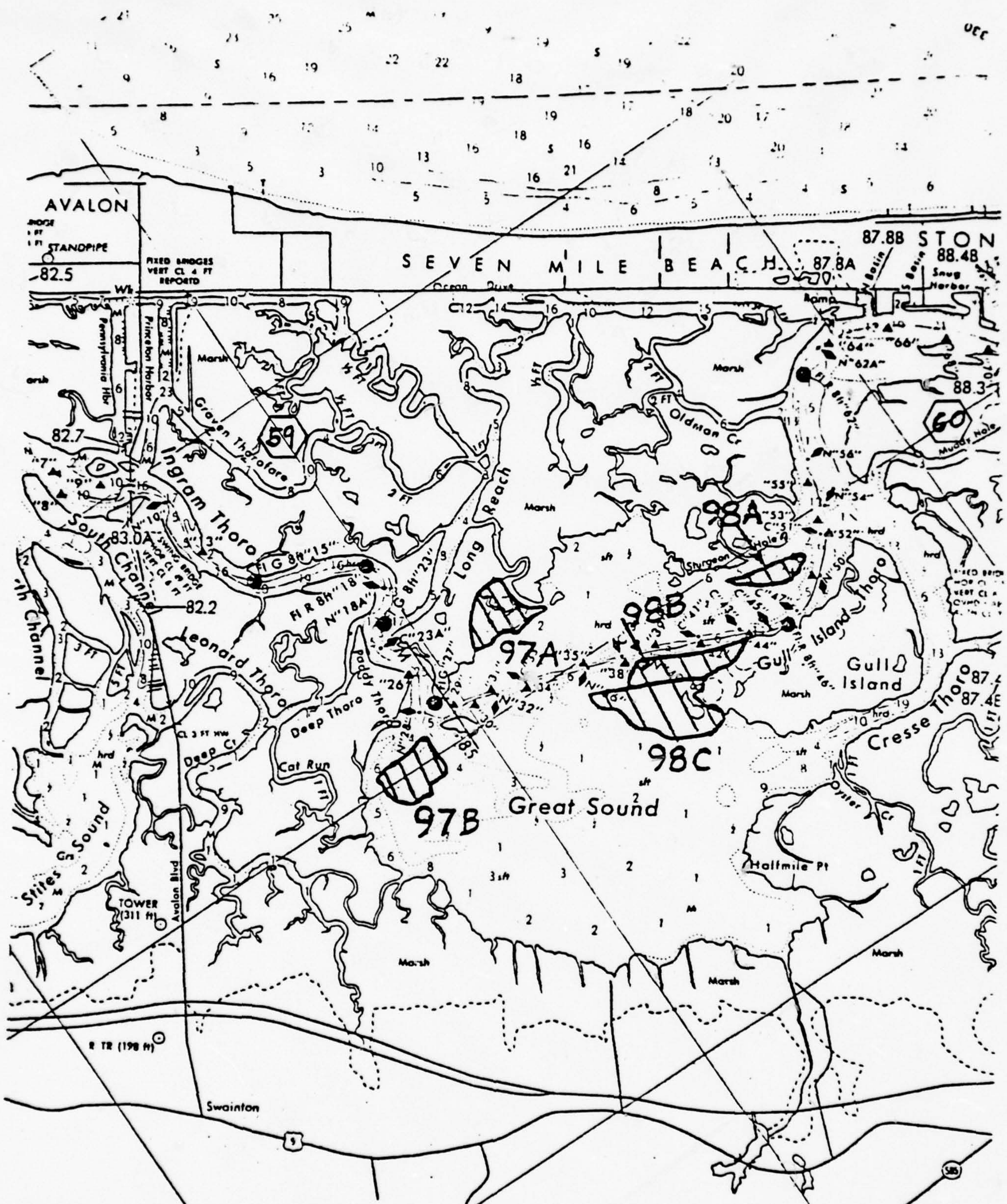

CORSON INLET (see note)
Strathmere
STANDPIPE
76.4B
76.4D
76.4A
76.4C
50
51
85
Ocean Drive
FIXED BRIDGE HOR CL 10 FT VERT CL 6 FT
BASCULE BRIDGE HOR CL 50 FT VERT CL 15 FT
Pipeline Area
Horn
Beach Creek
Weakfish Creek
Middle Thoro
Main Chan
Blackman Island
Devils Island
Devils Thoro
Corson Sound
Ben Hands Thoro
Upland Thoro
Edward
Marsh
84
84A
85A
85C
85B
86dm
39°14'
74°40'
74°42'
39°24'
Gravelly Run
TOWER
OVERHEAD POWER CABLE AUTHORIZED CL 100 FT
AREA 84 - 1966, 1976
AREA 84A - 1976
AREA 85A - 1966
AREA 85C - 1976
AREA 85B - 1966
AREA 86 - 1966, 1968
MAGNETIC
VAR 9°45'W (1969)
ANNUAL INCREASE 4'
13.5
11.7
South River
Stephen Cr
Estellville
39°22'
Gibs
CAUTION
Only marine radiobeacons have been calibrated for surface use. Radio direction-finder bearings to commercial broadcasting stations are subject to error and should be used with caution.
Station positions are shown thus:
(Accurate location)
(Approximate location)
13



AREA 90 - 1963, 1964, 1967, 1972, 1975

SHEET 14


FI R 4sec GONG
TOWNSEND INLET
Buoys not charted (see note D)
AVALON
BASCULE BRIDGE
HOR CL 50 FT
VERT CL 23 FT
STANDPIPE
FIXED BRIDGES
VERT CL 4 FT
REPORTED
FIXED BRIDGE
HOR CL 36 FT
VERT CL 6 FT
OVHD PWR CAB
AUTH CL 26 FT
TANK
SEVEN
RED SEC
56
TOWNSENDS INLET
58
57
55
59
TANK
Ludlam Beach
Ocean
Drive
Ludlam Thoro
Townsend Chan
Middle Thoro
North Channel
South Channel
Ingram Thoro
Graven
Cornell Harbor
Pennsylvania Hbr
Princeton Harbor
Marsh
FIXED BRIDGE
HOR CL 26 FT
VERT CL 6 FT
FIXED BRIDGE
HOR CL 80 FT
VERT CL 35 FT
Leonard Thoro
Long Reach
FIXED BRIDGE
HOR CL 30 FT
VERT CL 8 FT
OVHD PWR CAB
AUTH CL 35 FT
Deep Thoro
Deep Cr
Cat Run
Ware Thoro
Mill Thorofare
Clem Thoro
Bottle Creek
Kitts Thoro
Mill Creek
Mud Thorofare
Townsend Sound
Stites Sound
Uncle Aaron Cr
TOWER (311 ft)
Avalon Blvd
TOWER (311 ft)
Jeffers Landing
Lakes Creek
Garden State Parkway
R TR (198 ft)
Swainton
Harbor River
74°46'
74°40'
39°10'
STORM SIGNALS
SMALL CRAFT ADVISORY
GALE WARNING
14A



AREA 97A- 1964, 1965, 1968

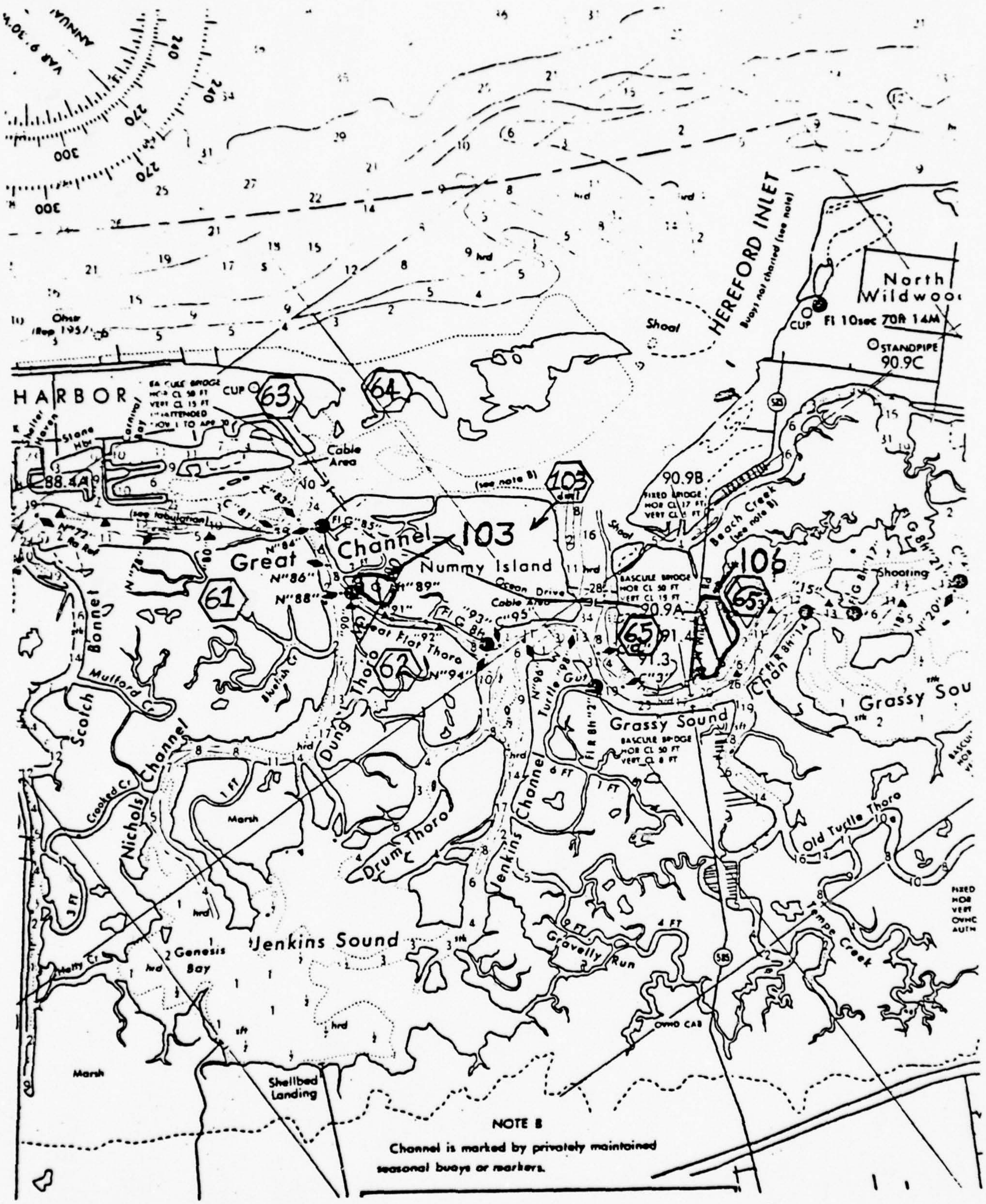
AREA 97B- 1964, 1965, 1968

AREA 98A- 1964, 1965, 1968

AREA 98B- 1964, 1965, 1968

AREA 98C- 1968, 1972, 1974

SHEET 15



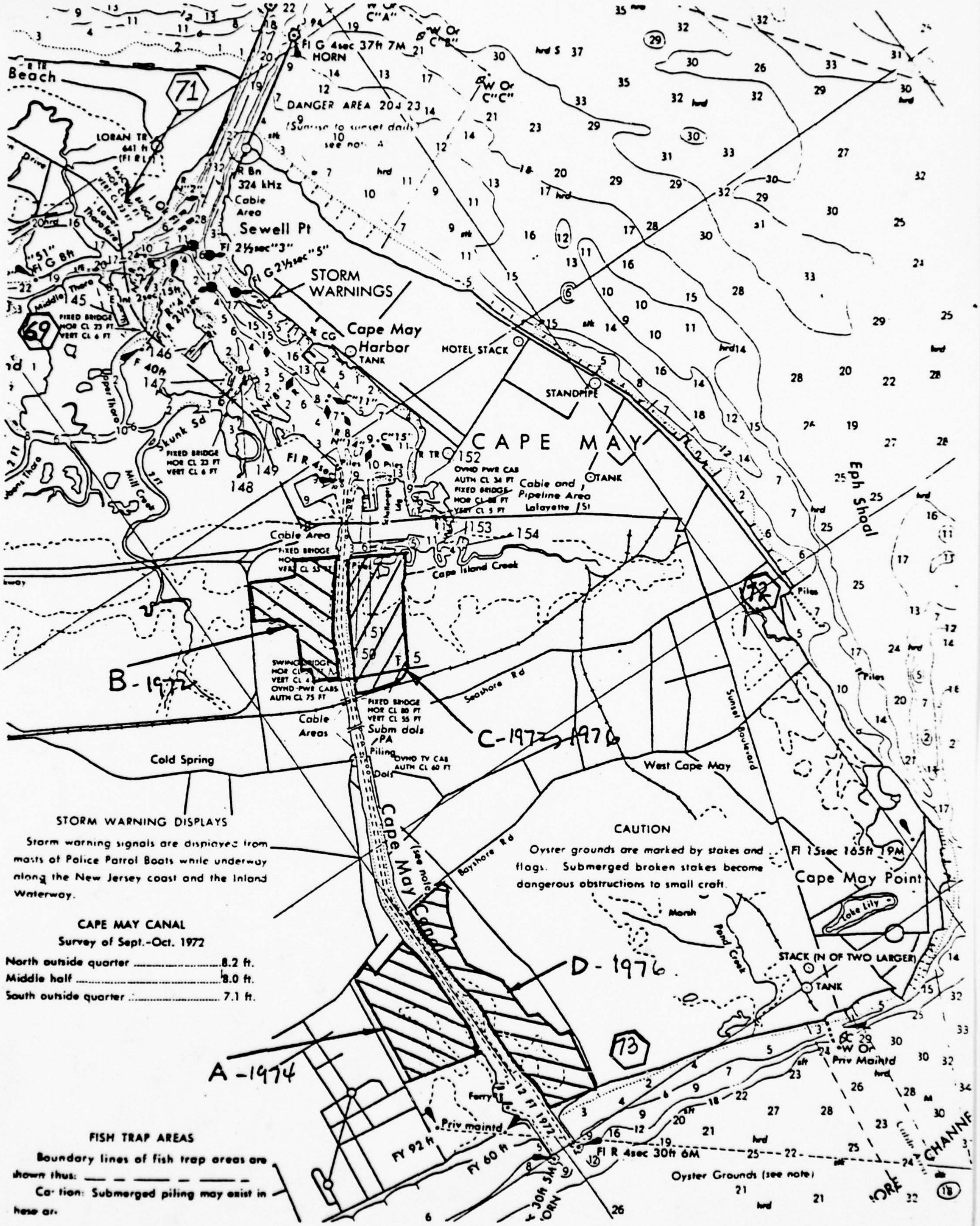
AREA 103 - 1964, 1968, 1975

AREA 106 - NOT USED SINCE 1963

SHEET 16

AREA 108A - 1966, 1968, 1974
AREA 108B - 1965
AREA 108C - THIS SITE HAS NEVER BEEN USED BY THE CORPS.
AREA 109 - 1965

SHEET 17



Beach
71
LORAN TR 641 ft (Fl R L)
Fl G 4sec 37ft 7M
HORN
DANGER AREA
(Sunrise to sunset daily)
R Bn 324 kHz
Cable Area
Sewell Pt
Fl 2½sec "3"
Fl 2½sec "5"
STORM WARNINGS
69
FIXED BRIDGE HOR CL 23 FT VERT CL 6 FT
Cape May Harbor
TANK
CG
HOTEL STACK
STANDPIPE
Skunk Sd
Mill Creek
CAPE MAY
TANK
Cable and Pipeline Area
Cable Area
Cape Island Creek
72
Piles
Eph Shoal
B-1972
C-1972-1976
Seashore Rd
Cable Areas
Subm dols
Piling
OVHD TV CAB AUTH CL 60 FT
Cold Spring
West Cape May
Sunset Boulevard
Bayshore Rd
Cape May Canal
(see note)
CAUTION
Oyster grounds are marked by stakes and flags. Submerged broken stakes become dangerous obstructions to small craft.
Fl 15sec 165ft 19M
Cape May Point
Lake Lily
Marsh
Pond Creek
STACK (N OF TWO LARGER)
TANK
D-1976
73
A-1974
Ferry
Priv maintd
12 FT 1972
FY 92 ft
FY 60 ft
Fl R 4sec 30ft 6M
Priv Maintd
Oyster Grounds (see note)
CHANNEL
STORM WARNING DISPLAYS
Storm warning signals are displayed from masts of Police Patrol Boats while underway along the New Jersey coast and the Inland Waterway.
CAPE MAY CANAL
Survey of Sept.-Oct. 1972
North outside quarter .... 8.2 ft.
Middle half .... 8.0 ft.
South outside quarter .... 7.1 ft.
FISH TRAP AREAS
Boundary lines of fish trap areas are shown thus:
Caution: Submerged piling may exist in these areas.

SHEET 18

FIGURE 3. Southern New Jersey Coast 1937

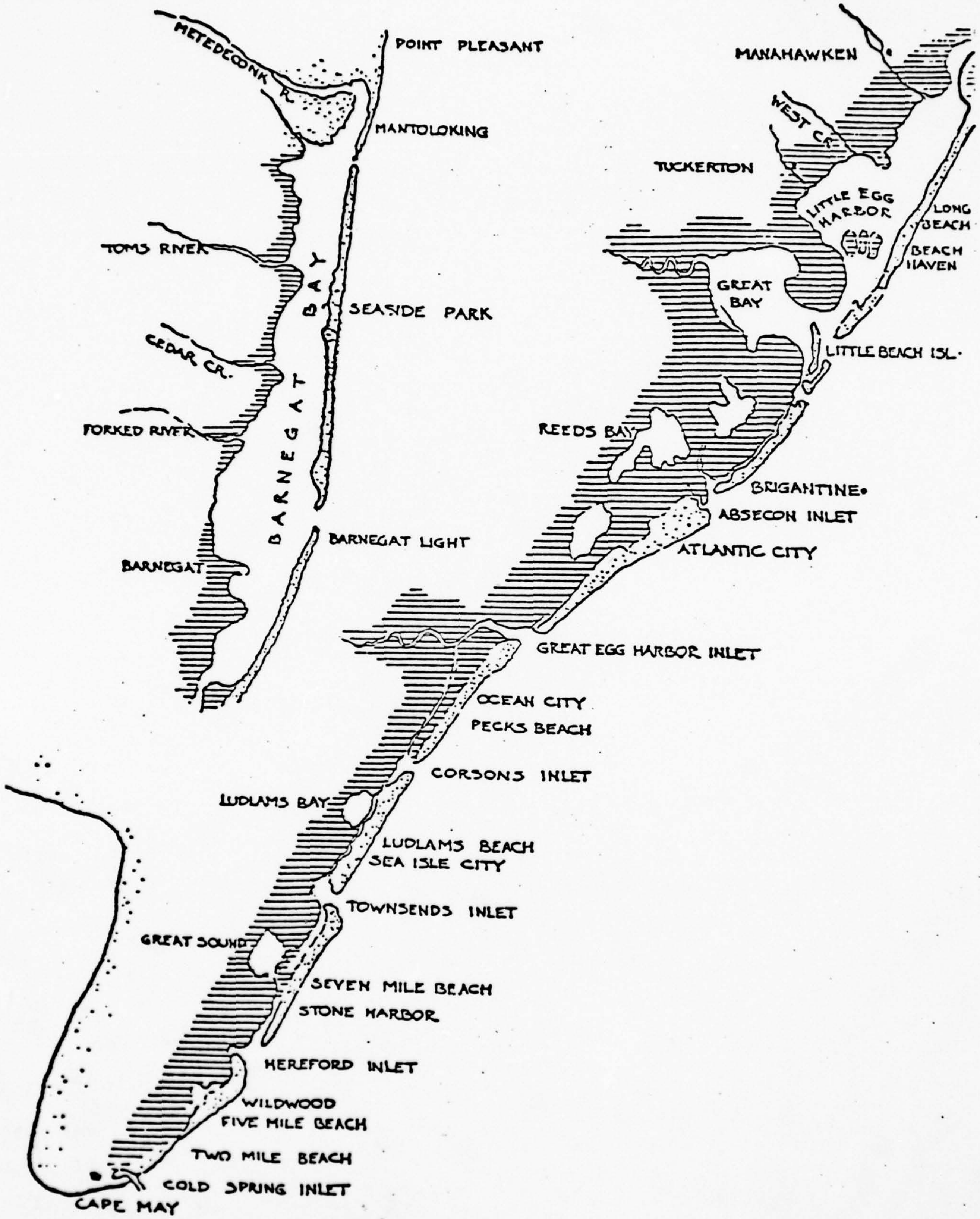
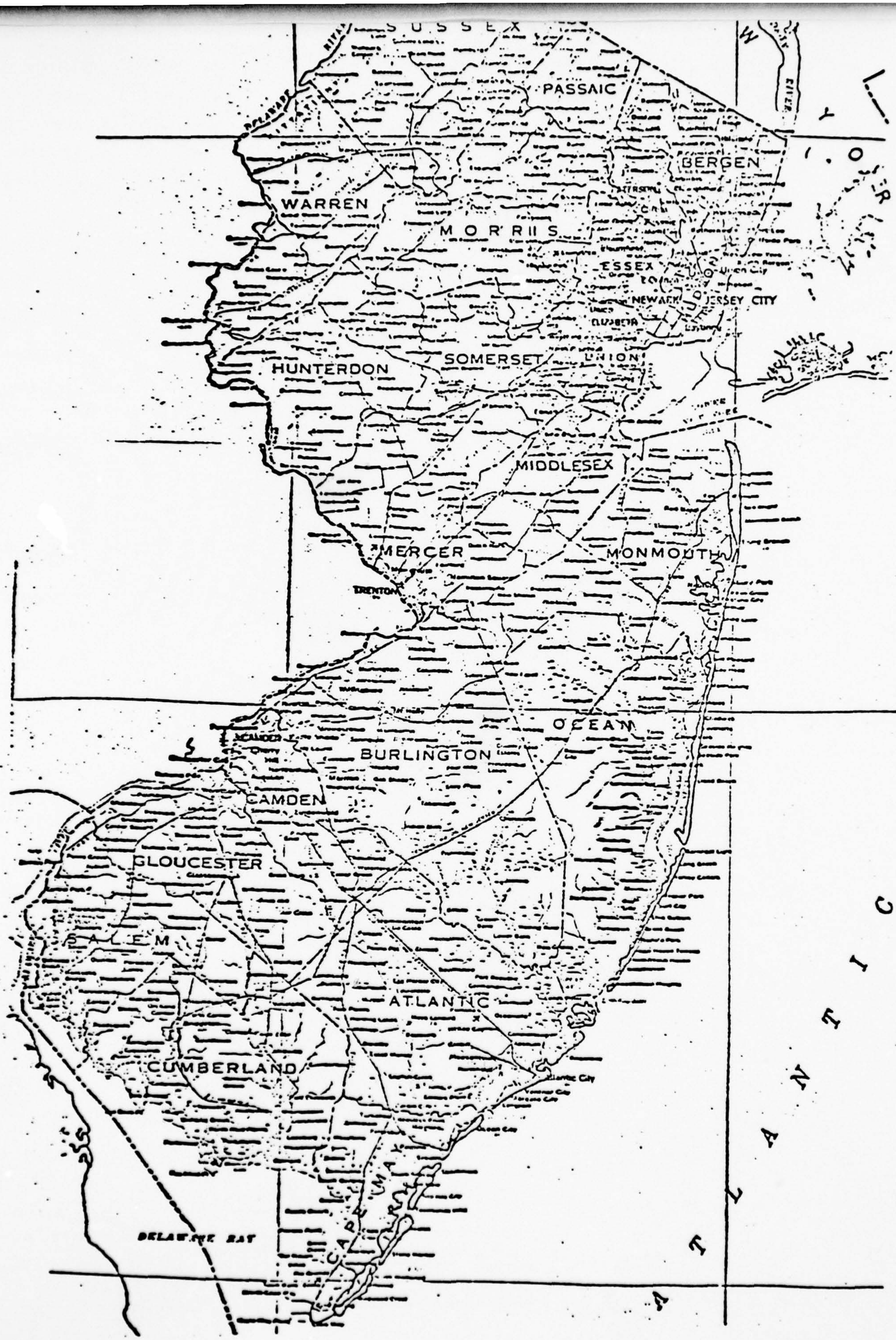

POINT PLEASANT
METEDECONK R.
MANTOLOKING
TOMS RIVER
BARNEGAT BAY
SEASIDE PARK
CEDAR CR.
FORKED RIVER
BARNEGAT LIGHT
BARNEGAT
MANAHAWKEN
WEST CR.
TUCKERTON
LITTLE EGG HARBOR
LONG BEACH
BEACH HAVEN
GREAT BAY
LITTLE BEACH ISL.
REEDS BAY
BRIGANTINE
ABSECON INLET
ATLANTIC CITY
GREAT EGG HARBOR INLET
OCEAN CITY
PECKS BEACH
CORSONS INLET
LUDLAMS BAY
LUDLAMS BEACH
SEA ISLE CITY
TOWNSENDS INLET
GREAT SOUND
SEVEN MILE BEACH
STONE HARBOR
HEREFORD INLET
WILDWOOD
FIVE MILE BEACH
TWO MILE BEACH
COLD SPRING INLET
CAPE MAY

FIGURE 4. New Jersey 1977


SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
NEWARK
JERSEY CITY
HUNTERDON
SOMERSET
UNION
MIDDLESEX
MERCER
MONMOUTH
TRENTON
OCEAN
BURLINGTON
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
DELAWARE BAY
ATLANTIC
NEW YORK

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DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-1

USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY

APPENDIX B: VEGETATION ANALYSIS

by

1 of 3 WES TR D-78-1, Jun 78, by C. A. McCaffrey, F. G. Buckley. Appendix B.

Manomet Bird Observatory
Manomet, Mass. 02345

Draft Copy

June 1978

Final Report

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under Contract No. DACW 39-76-C-0166
(DMRP Work Unit No. 4F01D)

Monitored by Environmental Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Technical Report D-78-1	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING BIRDS IN NEW JERSEY; APPENDIX B: VEGETATION ANALYSIS	5. TYPE OF REPORT & PERIOD COVERED: Final report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): 2 of 3 WES TR D-78-1, Jun 78, by C. A. McCaffrey, F. G. Buckley. Appendix B.	8. CONTRACT OR GRANT NUMBER(s): Contract No. DACW 39-76-C-0166
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Manomet Bird Observatory, Manomet, Mass. 02345	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: DMRP Work Unit No. 4F01D
11. CONTROLLING OFFICE NAME AND ADDRESS: Office, Chief of Engineers, U. S. Army, Washington, D. C. 20134	12. REPORT DATE: June 1978
	13. NUMBER OF PAGES: 226
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): U. S. Army Engineer Waterways Experiment Station, Environmental Laboratory, P. O. Box 631, Vicksburg, Miss. 39180	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Birds	New Jersey	Succession
Dredged material	Seabirds	Vegetation
Islands (Landforms)	Shore birds	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An analysis of vegetative characteristics on 21 selected dredged material islands along the Intracoastal Waterway of New Jersey was conducted during the summer and fall of 1977. Eleven of the study islands harbored colonially nesting birds; 10 did not. Vegetation maps showing the location of 14 major plant communities were prepared from low altitude infrared aerial imagery augmented as needed by ground-truthing. The average frequency, percent cover, and height classes of the dominant species were determined for each mapping

(continued)

20. ABSTRACT (Continued).

unit. The area covered by each plant community on individual study islands was then calculated. Plant communities, within the boundaries of the dredged material deposits, consisted of the following mapping units (in decreasing order of area covered by each): *Phragmites*, *Phragmites*-shrub, shrub, bare, shrub-dense grassland, sparse grassland, dense grassland, dike, shrub-forest, intertidal areas within the deposit, *Lonicera*, impounded water, and *Lonicera*-shrub.

Plant succession was inferred, where possible, by relating the age of the deposit to plant communities and island structure. Deposits of low profile are invaded by *Phragmites communis* which colonizes vast areas and persists until it is dominated by shrubs and trees. Domed deposits are slowly colonized by a sparse growth (less than 25% cover) of low grasses and forbs which persist for many years. The lower edges of these domes succeed to tall *Phragmites* stands and eventually to shrub thickets with trees. The few diked deposits studied were only one to two years old. By 1977, the deposits inside the dikes were still essentially bare and showed evidence of high soil salinity with occasional ponding of water.

This study was undertaken as part of a project to determine the use of dredged material islands by colonial seabirds and waterbirds in New Jersey for the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

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PREFACE

This report is a summary of the work accomplished during the summer and fall of 1977 as a part of the Dredged Material Research Program (DMRP), Work Unit 4F01D. The study was conducted under Contract No. DACW39-76-C-0166 between Manomet Bird Observatory, Manomet, Massachusetts, and the U. S. Army Engineer Waterways Experiment Station (WES). The DMRP was sponsored by the Office, Chief of Engineers, U. S. Army, and has been managed by the Environmental Laboratory (EL), WES.

This study was conducted by F. G. Buckley, Principal Investigator and C. A. McCaffrey, Vegetation Specialist.

A Number of persons have contributed to this report and by doing so, have made its completion possible.

Fred Lesser, Ocean County Mosquito Control Commission, provided logistic support and invaluable information about the dredged material islands in Ocean County. Dr. J. Shisler, Rutgers University, also gave logistic support and help with field sampling in Ocean County. Judy Hansen, Cape May Mosquito Control Commission, was helpful with logistic support in Cape May County, as were Dr. J. B. Durand and Roger Hoden, Rutgers Marine Sciences Field Station, Tuckerton, N.J., in Atlantic County.

Dr. P. Godfrey, University of Massachusetts, advised on technical aspects of this study. Harry E. Ahles, also of the University of Massachusetts, identified several, and verified all, plant specimens collected for this study.

Dr. R. Best, S. Laerm and J. Richardson of the Institute of Ecology, University of Georgia and Dr. E. Franz, Dept. of Botany, University of Georgia, made suggestions and gave assistance that is especially appreciated. The Department of Geography and Institute of Ecology, of the University of Georgia, provided many indispensable services to the production of this report and they are gratefully acknowledged here.

D. Kodama, provided field assistance to C. McCaffrey in New Jersey, and was an invaluable asset to this study.

E. Weiss, D. Marks, C. Hendrix, and L. Poston, all provided technical assistance and J. Southerland, University of Georgia, drafted the maps appearing in this report.

Dr. P. A. Buckley, of the National Park Service, and Rutgers University, gave freely of his advice and expertise, and this report would not have been completed without him.

Ms. M. Landin of the Waterways Experiment Station was especially helpful with certain aspects of this study and for this we thank her.

This study was conducted under the supervision of Ms. Mary Landin, Contract Manager, Habitat Development Project (HDP), EL, and under the general supervision of Dr. Hanley K. Smith, Project Manager, HDP, and Dr. John Harrison, Chief, EL.

Director of WES during the conduct of this study and publication of this report was COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
miles (U. S. Statute)	1.609344	kilometers
feet	0.3048	meters
inches	0.0254	meters
degrees (angular)	0.01745329	radians
pounds (mass)	0.4535924	kilograms
gallons (U. S. liquid)	0.2642	liters

PART I: INTRODUCTION

1. The objectives of Phase III of "A study of the use of dredged material islands by colonially nesting seabirds and wading birds in New Jersey" was to determine the major plant communities, their characteristics and their successional patterns, on 21 dredged material islands along the New Jersey portion of the Intracoastal Waterway. The length and breadth (plus a mile* swath on either side) of the waterway determined the boundaries of the specific study area in New Jersey which extended 117 miles from Manasquan Inlet on the north, to the mouth of the Cape May Canal on the south. It followed the waterway as it passes through shallow bays (lagoons) and broad salt marshes west of a series of generally heavily developed barrier islands in Ocean, Atlantic and Cape May Counties.

2. Certain terminology used in this report as it pertains to New Jersey requires clarification. A "dredged material island" is generally not an island in the usual sense, but that part of an island or salt marsh, usually elevated, where dredged material has been deposited and which is discrete and bounded by a conspicuously different type of material. It may or may not be vegetated; it may or may not be diked. "Deposit" refers to that portion of a dredged material island where the dredged material has actually been emplaced; it may or may not be coterminous with "dredged material island" depending on location. A "study island" is one of the 21 dredged material islands chosen for intensive vegetative analysis; eleven harboured colonially nesting birds (bird islands) and ten did not (vegetation islands).

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* A table for converting U. S. customary units of measurement to metric (SI) units is given on page 13.

PART II: MATERIALS AND METHODS

Introduction

3. Approximately ~~2500~~ 200 islands known or suspected to be of dredged material origin are located within the specific study area. Of these, 21 were selected for detailed vegetative analysis; 11 of these harboured colonially nesting bird colonies and 10 did not.

4. Field reconnaissance and sampling were conducted on each study island to determine frequency, percent cover and height of dominant plant species. Major plant communities (mapping units) were mapped using color infrared aerial photographs and field data. The area covered by each study island and by each mapping unit was determined by use of a dot grid.

5. Soil samples were collected on all study islands and transmitted to the Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Mississippi.

Photointerpretation

6. The major tool used in preparation of vegetative cover maps for the study islands was analysis of 9"x9" false-color infrared Ektachrome transparencies taken especially for this study in July and August 1977, to coincide with that portion of the growing season having the greatest representation of spring, summer and fall aspect vegetation. Photointerpretation was augmented by on-site ground-truthing (see below). Islands were photographed at three altitudes varying with island size: 1400 ft (426 meters), 1200 ft (365 meters) and 1000 ft (305 meters); most were photographed from the latter altitude. Most islands were easily included on one frame, but several required a series of overlapping transparencies. Each frame recorded the time the photo was taken as well as true/magnetic compass direction.

7. One-on-One outlines of the major vegetative bands were drawn on clear acetate atop the 9x9 photographs, and refined as needed. Plant communities observed in the field were located on the aerial photos, and areas of similar colortone, texture and density, were assumed to have similar plant composition unless proven otherwise. (See Anderson and Webber 1973, and

Fornes and Reimold 1973 for details.)

8. Initial analysis yielded 43 discernible mapping units, representing 43 recognizable plant associations. As this was clearly too detailed and cumbersome for the present study, a community approach was taken, allowing reduction of the 43 units to a more manageable and usable 14; these are described in detail in PART III: MAPPING UNIT DESCRIPTIONS and are the categories finally depicted on the vegetative cover maps prepared for each study island.

9. Plant community designations were a composite of several factors: dominant species composition, ground cover by growth form, and visual density of plants. These were determined by on-site ground-truthing and field transects which were located on the 9x9 photographs for most of the study islands. Distances between definable features along the transects were measured and an exact scale for each photograph was determined. Using the ratio of "photo-millimeters to ground meters," it was thus possible to locate precisely the associations noted during line intercept sampling procedures. However, the scales on the vegetative maps for islands where no transects were made are best considered approximate since they were computed from the relationship between camera focal lengths and altitudes, the latter rounded to the nearest 100 feet. The north arrows on all maps were determined from plane compass directions at the time of each photograph, rounded to the nearest 10 degrees.

10. In addition to the 14 mapping units, all areas of "drift" material (vegetation deposited in windrows by tidal and wind action) on the 21 study islands were also plotted. These were not placed directly on the vegetation maps for each island but were depicted on separate "drift overlays" for each study island. These drift deposits are believed to be important habitat features for certain colonially nesting waterbirds.

Vegetation Analysis: Ground Sampling Techniques

11. During mid-June through July 1977 all 21 study islands were visited for on-site verification of plant communities, for collection of voucher herbarium specimens and for soil sample collection (see below). Islands were reached by skiff with outboard motor, by wading or walking to them, and by helicopter, as appropriate. In addition, all were surveyed aerially

by fixed-wing aircraft during which photographs and notes pertaining to the island vegetation were taken.

12. Three methods of vegetation analysis were performed on-site: (1) general field reconnaissance, (2) line intercept, and (3) quadrat sampling. All three methods were used on study islands A12, A35, 45A, A61c, 103, and 109 (bird islands) and on A12 North, A43a, 51B, 78B South and 109 South (vegetation islands). On study island 109, vegetation was not sampled directly on the area chosen for colony nest site study because human passage through the vegetation would have damaged the area. Instead, sampling was confined to an adjacent deposit area having superficially similar vegetative associations.

13. Field reconnaissance alone was used on islands with similar plant associations to islands already sampled (45B, 58a, 85C, 85 South, 108B), or on islands where time consuming sampling would have unduly disturbed nesting birds (X27, 85dmi, 98A, 98B South, 98B North). During field reconnaissance all plant associations on each study island were described and frequency, cover, and height classes of the dominant species were recorded for each association.

14. The choice of transect location was based upon two criteria: (1) to cross as many associations as possible per deposit; and (2) to pass through associations not previously sampled on other islands. In this manner, data representative of the study island vegetation and variety within plant communities would be represented by sampled data. Straight line transects were set up using a hand-held compass, wire flags, and meter tape. The number of transects sampled on each study island varied according to the preceding criteria but at least one or two lines were usually sampled. Line intercept measurements of plant association extent and location were made. During sampling, notation was made of the distance on the meter tape at which plant associations changed. Dominant species within 1 meter of both sides of the tape were recorded and the nature of the substrate was also noted.

15. Quadrat sampling was also done for both herb and shrub quadrats. Herb quadrats were 1x1 meter in size and were sampled at every other meter along the meter tape. Shrub quadrats measured 2 meters square and were

sampled every 5 meters. *Phragmites communis* (after Fernald 1950) was treated as a shrub when it exceeded 25 percent cover and 1 meter in height. All growth forms were sampled in the herb quadrats, while only shrubs, trees and *Phragmites* were sampled in the shrub quadrats. In *Phragmites* stands and in shrub thickets, sampling was done every 5 meters and each shrub quadrat included a nested herb quadrat. Frequency, cover and height class data were also recorded for each quadrat sampled.

16. On study islands that had diked dredged material deposits, the dikes were sampled somewhat differently from the preceding methods. At one or two locations, a meter tape was extended, usually for 30 meters, along the top of the dike. Flags were then placed at 5 meter intervals along the tape. At each flag a line was extended across the top of the dike (usually 4 meters to the outside and 7 meters on the inside) to the "toes" of the dike. Shrub and herb quadrats (1x1 meter) were sampled at each meter on both sides of the dike.

Frequency, Cover, and Height Data Classification

17. Field sampling and visual observation methods, already discussed, were used to determine criteria for classification of frequency, cover and height data for the dominant or major plant species found on the 21 study islands. These criteria and the resulting system of classification are presented here and again in tabular form in Appendix B'.

FREQUENCY CLASS EQUIVALENTS

CLASS	PRESENT IN % OF ALL MAPPING UNIT QUADRATS
1	0-25
2	26-50
3	51-75
4	76-100

COVER CLASS EQUIVALENTS

CLASS	% OF GROUND SURFACE COVERED
1	0-5
2	6-25
3	26-50
4	51-75
5	76-100

HEIGHT CLASS EQUIVALENTS

CLASS	HEIGHT IN METERS
1	0-0.10
2	0.11-0.50
3	0.51-1.0
4	1.01-2.0
5	2.01-4.0
6	4.01-10.0

18. Tables B2-B4, Appendix B', summarize frequency, cover and height class data for each dominant species found in each mapping unit, and present the data as an average class value computed from all quadrats across all study islands sampled. Data for major species in each mapping unit on particular islands were computed from all quadrats sampled on that island, within the mapping unit indicated. These data are presented in tables following each study island description.

Dominant Species Determination

19. The status of a particular plant species as "dominant" was determined by its frequency of occurrence across all quadrats sampled on all

study islands. Those species exhibiting the highest percent frequency and having a cover class of atleast 2 (6-25%) were determined to be dominant species. Certain of these species were not necessarily those exhibiting the highest percent frequency in mapping units or quadrats sampled on individual study islands in each place that they occurred.

20. Species occurring at low frequency and cover classes (less than twenty-five percent frequency and cover) were considered to be minor species. All plant species collected or encountered on individual study islands are listed on Table A1, Appendix A'.

Area Computation

21. The area covered by each mapping unit and by the entire dredged material deposit was determined by use of a dot grid (Avery 1968). This standard technique is performed by random placement (to avoid bias in positioning) of a dot grid over the area to be measured. Dots covering each mapping unit area were counted and totaled by mapping unit. This total was multiplied by conversion factors equivalent to hectares and acres per dot, and based upon the number of dots covering a known area at the scale of each particular aerial photograph.

22. Tables following each island description, provide the size of the dredged material deposit areas as well as entire island sizes (where applicable). Area size and percent of deposit areas are also given for each mapping unit.

23. The intertidal area measured consisted of a 70 m. (200 ft.) band around the deposit if the dredged material was located on a continuous marsh expanse. On distinct islands, it included the entire marsh area. Islands 109 and A61c were exceptions to this, because adequate imagery of the entirety of these islands was unavailable; thus their mapped intertidal areas included only a 70 m. (200 ft.) band bordering the study deposit. Mapping unit areas within the measured intertidal areas but occurring apart from dredged material deposit areas are given on separate tables following each island's description.

24. Measurement of the drift mapping unit areas were taken from the drift overlay maps for each study island. Separate tables providing drift data list them under three separate categories: (1) drift on deposit areas; (2) drift on the upper edge of the marsh bordering the dredged material

deposit (edge drift); and (3) drift located at random through the intertidal area (adjacent drift). The percent of the deposit area covered by drift is also given. The base vegetation maps do not indicate separate mapping units for "drift" but include areas of drift within mapping units indicating vegetation communities underlying the drift.

Soil Sampling

25. Soil samples representative of the upper 15 cm of soil were collected in the major plant communities on each study island. On deposits where transects were sampled, the soil was collected along the transect lines. On other islands, it was collected in the major plant communities after field reconnaissance. Approximately 45 kg (100 lbs) of soil samples were shipped to the U. S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, for their analysis and use.

Figure 1. Bare mapping unit. Area behind dike with *Phragmites* in background on study island 45A.

PART III: MAPPING UNIT DESCRIPTIONS

26. Fifteen mapping units were used to locate distinct plant communities and physical features of the dredged material islands and their surroundings. The plant communities shown on the vegetation maps in Part IV usually include several plant associations. In this section the consistent features of each mapping unit, as well as the various plant associations included in each community, are described.

Bare

27. The bare mapping unit has little to no vegetative cover. It occurs in three situations: 1) on domes; 2) as beach; and 3) behind dikes. The dome of study island A12 North is almost completely bare. Individuals of the species vegetating sparse grassland domes (see sparse grassland description) occasionally occur, but offer negligible ground cover.

28. Essentially bare beaches occur on study island 51B and 78B South. These beaches are sandwiched between the upland vegetation and intertidal areas not protected by extensive marshes. Drift lines with their associated vegetation are found at some places on the beaches (see sparse grassland description for species). Otherwise the following species are occasionally seen growing in the sand: *Spartina alterniflora, Salicornia europaea, Spergularia marina,* and *Bassia hirsuta.* On other dredged material islands, sandy areas of insignificant size which could be considered small beaches, are included with the intertidal mapping unit.

29. The greatest areas included within the bare mapping unit of study island 45a are found behind the dikes on diked islands (Fig. 1). Most of the sediment deposited there seems to remain unvegetated for at least two years after deposition. Inundation may discourage colonization of the area. Polygons of cracked sediment observed on much of the bare area are evidence of periodic flooding followed by evaporation. Salt water flooding from dredged material deposition or from extremely high or storm tides would have a long term effect in deterring invasion by salt intolerant species.

30. The area between the inner toe of the dike and the *Phragmites communis* center consists mostly of bare sediment (sand and clay). Several salt tolerant species were also found to occur infrequently: *Salicornia europaea, Sesuvium maritima, Spergularia marina, Bassia hirsuta, Suaeda*

Figure 2. Sparse grassland mapping unit. Study island A12.

maritima, Spartina patens, Spartina alterniflora, and *Distichlis spicata.* Other species found here were not necessarily characteristic of saline associations: *Chenopodium album, Chenopodium ambrosioides, Atriplex patula* var. *hastata,* and *Phragmites communis.*

Sparse Grassland

31. The sparse grassland mapping unit (Fig. 2) represents either xeric plant associations with vegetation usually less than 0.2 m. tall or areas in early succession with herbs and grasses less than 1 m. tall. Three types are recognized within this mapping unit: 1) essentially bare; 2) sparse grassland (typical); and 3) early drift succession.

32. The essentially bare type was found only on the dome of island A12. Species present, were the same as those on the typical sparse grassland described below. Both sparse grassland types merge with no definite boundary. The vegetation on the essentially bare area was less than 0.1 m. tall and covered less than 5% of the ground.

33. The typical sparse grassland was found on domed deposits (A12, A12 North, and 51B) and had numerous individuals which covered less than 25% of the ground. The plants stood less than 0.2 m. tall. Species at the dome top varied between islands depending upon age, and height above ground water level. The most common species were: *Erigeron pusillus, Bromus tectorum, Oenothera parviflora, Vulpia octoflora, Solidago sempervirens,* and *Eragrostis spectablis (?).* The latter two had higher cover and frequency on lower elevations of the dome than at the apex. Around the base of the dome, *Ammophila breviligulata,* standing 0.1-0.5 m. tall, and *Phragmites communis,* 0.5-1 m. in height, occurred independently and covered 25-50% of the area. The other sparse grassland species are of minor importance at the base.

34. The typical sparse grassland is not restricted to domed deposits. The sparse grassland behind the dike on study island 103 includes *Chenopodium album, Atriplex patula* var. *hastata,* and *Phragmites communis* (1-2 m. tall) in scattered patches.

35. Typical sparse grassland occurred in a small area on study island 109 where *Solidago Sempervirens,* as the major species, covered less than 25% of the ground. On study island 109 South, there was a small area which

Figure 3. Dense grassland mapping unit. *Ammophila breviligulata* dominant on study island X27.

appeared to be a blowout. It had 5% or less cover including species which are minor on the domes: *Cyperus* sp., *V. octoflora,* and *Lepidium virginicum.* In addition to these, numerous *Rhus copallina* seedlings were found.

36. The third type which was classified as sparse grassland is drift in an early stage of succession. This occurs on study island 51B and 78B South. On 51B, drift deposits covered patches of the sand on the lower part of the dome. The sand patches were vegetated by less than 5% cover of *A. breviligulata* and *P. communis* (1-2 m. high).

37. On the inlet side of 78B South, a more typical assemblage of plants vegetating drift mats was found. This drift was on the upper edge of a sandy beach bordering the intertidal area. More than 30 species were recorded here, covering about 75% of the drift and sand base. They included herbs and grasses less than 0.5 m. tall. The most abundant species here were: *Cakile edentula, Chenopodium album, Chenopodium ambrosioides, A. patula* var., *hastata, Lactuca* sp., *L. virginicum, Cyperus esculentus,* and *Spartina patens.*

Dense Grassland

38. The dense grassland mapping unit was composed of low (0.1-0.5 m.) grasses and herbs. Scattered patches of the sand or drift substrate were occasionally exposed. Dense grassland vegetation covered about 5 through 50-75% of the ground. Species composition varied among the three main associations: 1) *Ammophila* dense grassland; 2) mixed dense grassland; and 3) drift in early succession.

39. *Ammophila breviligulata* dominated some grasslands (Fig. 3) with *Solidago sempervirens, Lepidium virginicum* and several other herbs also present. Near drift lines, which occasionally occurred in *Ammophila* grasslands *Cakile edentula* occurred with the other herbs mentioned above.

40. In the mixed dense grassland association, the word "grassland" is used loosely to include a dominance of herbs as well as grasses. There was considerable variation in species composition between grassland locations. The grasses dominant on the islands include: *Panicum lanuginosum* on 109 South; *Festuca rubra* on 45A; *Andropogon scoparius* on 78B south; and *Panicum virgatum* on 98B South. The dominant herbs included: *Solidago sempervirens, Cirsium arvense, Achillea millefolium,* and *Phragmites communis* (less than

Figure 4. *Phragmites* mapping unit. *Phragmites communis* dominant with occasional *Baccharis halimifolia*.

1 m. tall). These plants grew on a base of drift on study islands A35 and X27. The dense grasslands on study island 45A, 98B South, and 109 South are in transition to a mid-seral stage. Scattered shrubs and vines which are indicative of this were: *Baccharis halimifolia, Myrica pensylvanica, Rhus copallina, R. radicans, Lonicera japonica,* and *Juniperus virginiana.*

41. The third association, drift in early succession, occurred on study islands A35 and X27. Drift covered the ground with herbs covering 25-50% of the drift. The herbs included: *Solidago sempervirens, S. tenuifolia, L. virginicum, Strophostyles helvola, Cakile edentula, Convovulus sepium* and scattered individuals of *Phragmites communis* (1-2 m tall). Mid-seral transition was indicated by the presence of *Myrica pensylvanica* and *R. radicans.*

42. Drift succession in a high marsh area on study island A35 had about equal cover (25-50%) of drift and *Spartina patens.* The drift was vegetated by species commonly associated with it in saline situations: *C. edentula, Spergularia marina, Spartina alterniflora,* and *Iva Frutescens.*

43. One additional location of "dense grassland" did not fit into any of the above descriptions -- the lawn which surrounds a cottage situated on island 45B.

Phragmites

44. The *Phragmites* mapping unit (Fig. 4) is dominated by *Phragmites communis.* This grass colonizes vast areas by prolific rhizomatous growth; in some places it excludes all other species. It ranges from 1-3 m. in height on the New Jersey dredged material islands. *Phragmites* forms dense stands in which stems from previous years remain mixed with the current year's growth.

45. Five types of *Phragmites* associations were recognized in the field and on the aerial imagery: 1) closed *Phragmites;* 2) open *Phragmites;* 3) *Phragmites-Ammophila* grassland; 4) *Phragmites* - high marsh; and 5) sparse *Phragmites.*

46. Closed stands were exclusively *Phragmites.* They had a high stem density (live and dead), low light penetration, and were 2-3 m. tall. Open *Phragmites* areas were found commonly at the edge of vegetation types which were low or where light could penetrate laterally. Compared with the closed stands, there appeared to be a lower stem density and shorter height

(about 1-2 m.), which permitted greater light penetration. Several herbs and herbaceous vines grow in these open stands forming a noticeable herb layer in places.

47. On study island 51B, most of the *Phragmites* (1-1.5 m. tall) grew in open stands with a dense grassland herb layer composed chiefly of *Ammophila breviligula* and *Solidago sempervirens*.

48. The fourth type, *Phragmites*-high marsh, occurs as *Phragmites* extends marshward from the parent stand. The reed grows with upper marsh vegetation composed mainly of *Spartina patens, Limonium nashii,* and *Salicornia* europaea.

48a. *Myrica pensylvanica* and *Baccharis halimifolia,* (both live and dead shrubs) were occasionally interspersed with the reed in all of the above associations as succession proceeded to a *Phragmites*-shrub stage.

49. *Phragmites* colonization of drift material will result in any of the above associations. In these areas, a drift mat occurs beneath the *Phragmites*.

50. Sparse *Phragmites* patches extended from denser stands in the middle of the diked islands (45A, 85C, and 103). On 45A and 103, the reed was colonizing the bare area behind the dike and was in a sparse arrangement close to the parent stand. The reed was usually less than 1 m. tall and covered less than 5% of the ground leaving bare sand exposed to view. No other species were found in the sparse *Phragmites* areas.

51. On study island 85C, the sparse growth was the result of about 0.6 m. of aeolian sand burial of a once dense patch of *Phragmites*. Here the reed was 2 m. (6 ft.) high and covered less than 25% of the ground. Dead plants of *Phragmites* and occasional *M. pensylvanica* protruded through the sand.

Phragmites-Shrub

52. The *Phragmites* - shrub community was often extensive and was found on most of the study islands. Two main types were recognizable on the imagery: 1) typical *Phragmites* - shrub and 2) *Phragmites* -shrub with a

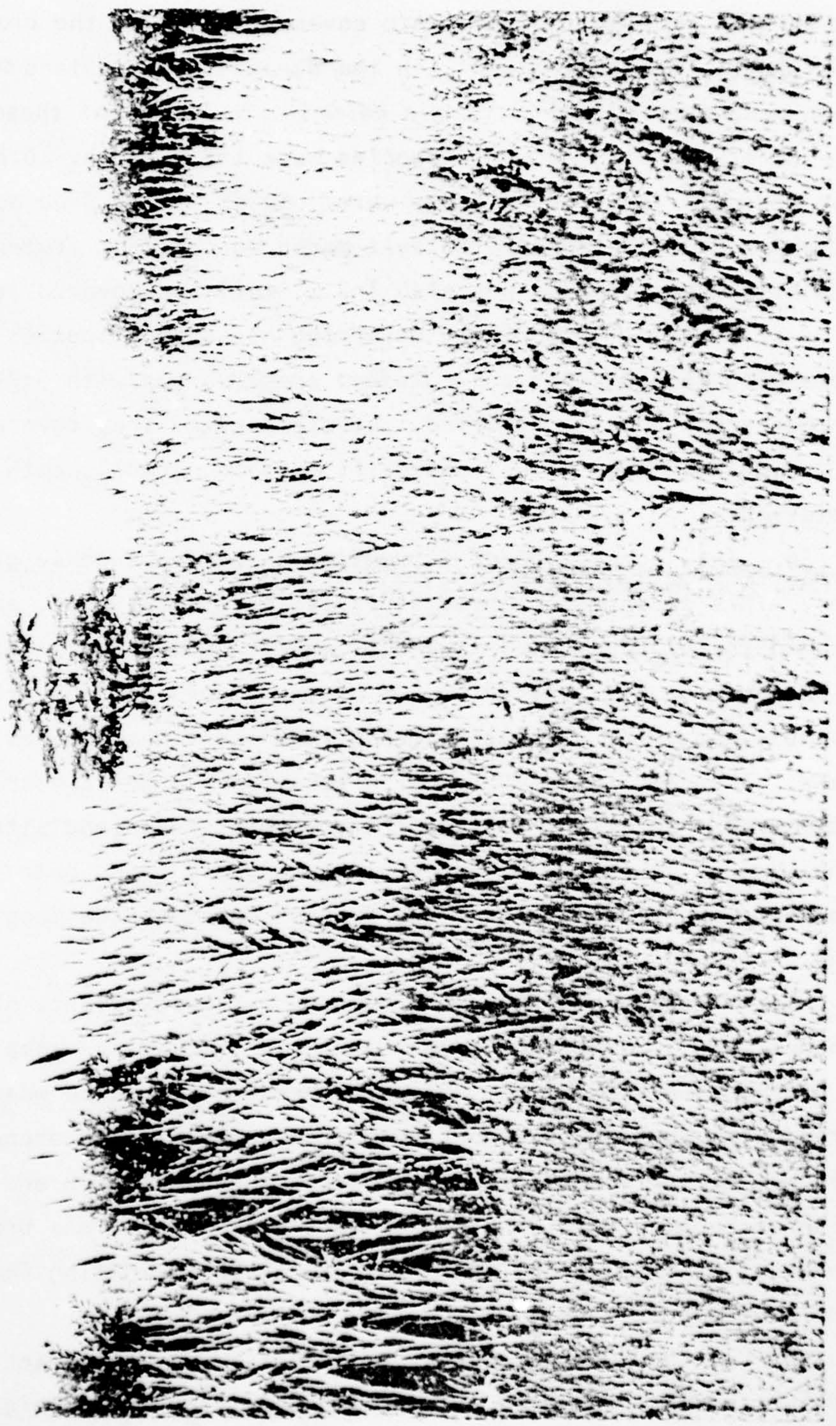

Figure 5. *Phragmites* - shrub mapping unit. *Myrica pensylvanica* and *Phragmites communis* on study island 78B South.

dense grassland ground cover.

53. The typical *Phragmites*-shrub was tall and dense. The characteristics described for the *Phragmites* community generally apply for this mapping unit as well. *Phragmites communis* covered 50-75% of the ground and averaged 2-4 m. high. Randomly mixed with the *Phragmites* on upland sites (Fig. 5) was *Myrica pensylvanica* and *Baccharis halimifolia*. Each of these shrubs covered less than 25% of the area and both species were 1-2 m. high. Other shrubs sharing these characteristics as a group were: *Salix nigra, Rhus copallina,* and *Sambucus canadensis*. Near the salt marsh border, *Iva frutescens* was the dominant shrub. The *Iva* was also 1-2 m. tall and covered less than 25% of the area. The most frequently occurring herbaceous species were: *Spartina patens* with 25-50% cover and *Solidago sempervirens* with 5-25% cover. Numerous other species occurred, but altogether, they covered only 5-25% of the ground. In some situations drift mats occurred beneath the taller vegetation.

54. The second type of *Phragmites*-shrub had a dense grassland herb layer. This occurred on three study islands: 51B, A61c, and 98B South. *P. communis, M. pensylvanica,* and *B. halimifolia* were the dominant species, but *Phragmites* only covered 25-50% of the ground and was 1-2 m. in height. Thus, the community was not as dense in these locations, as it was, in the others. The herb layer varied with location. *Ammophila breviligulata* and *Festuca rubra* were the more important species on upland sites, whereas *F. rubra, Juncus gerardi,* and *Spartina patens* were found near the high marsh in association with drift and the *Iva* component of the mapping unit.

Shrub

55. Shrub communities were composed of woody plants of various heights. Branches were usually interwoven forming a thicket and completely covering the ground when viewed from above. *Phragmites communis* was often interspersed with the shrubs, and ranged from occasional to abundant. The herb layer was either absent or was composed of several herb and grass species. The shrub mapping unit occurred on most deposits and was broken into three main associations: 1) upland shrub; 2) shrub dominating *Phragmites*; and 3) *Iva frutescens*.

56. In the upland shrub type, thickets were dominated by *Myrica pensylvanica* and *Baccharis halimifolia* about 2-4 m. in height. Vines of

Figure 6. Shrub-forest mapping unit. *Juniperus virginiana*, *Iva frutescens*, *Baccharis halimifolia* and *Rhus radicans* on study island 78B South.

AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3
USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166
UNCLASSIFIED WES-TR-D-78-1 NL

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Rhus radicans and *Parthenocissus quinquefolia* occurred commonly throughout the thickets. *P. communis* (1-2 m. tall) covered less than 25% of the thicket. The ground was generally bare in the middle of dense stands, but *Spartina patens*, *Festuca rubra*, and *Achillea millefolium* did cover the ground in areas receiving sufficient light for their growth, e.g. on thicket edges.

57. The shrub thickets on study islands 85 South, 98A, 109, and 109 South also included *Rhus copallina* as an important shrub sharing the canopy. On study island 109, it was one of the dominant shrubs. Study island 109 South had an abundance of the vine, *Lonicera japonica*, growing over the shrub thickets. *Sambucus canadensis* was also common on this island (it was also present on other dredged material islands).

58. The second association, shrub dominating *Phragmites*, was in late transition from a *Phragmites*-shrub community to a shrub thicket. *P. communis* covered 25-50% of the area and was 1-2 m. tall, slightly shorter and less dominant than the shrubs. Because of shrub domination over the *Phragmites*, this association was considered part of the shrub community. It occurred either in a thicket-like arrangement or the plants were more widely spaced, forming an open association.

59. The third type of shrubland had 75-100% cover of *I. frutescens*, 1-2 m. (3-6 ft.) tall. This thicket occurred on areas slightly elevated above the intertidal surface. Drift material often covered much of the ground beneath the shrubs. A dense herb layer was present in most situations. It was composed of *Spartina patens*, *Juncus gerardi*, and to a lesser degree, *Festuca rubra*. *I. frutescens* seedlings were numerous. *Phragmites communis* (1-2 m. tall) was freqently present but covered less than 25% of the area. Such halophytes as *Spartina alterniflora*, *Salicornia europaea*, *Distichlis spicata*, and *Limonium nashii* were often present where high marsh vegetation extended beneath the *I. frutescens*.

Shrub-Forest

60. The shrub-forest mapping unit is of minor importance on the New Jersey dredged material islands studied. This type had its greatest area on 78B South and 98B South (Fig. 6). The shrub component of this community was the

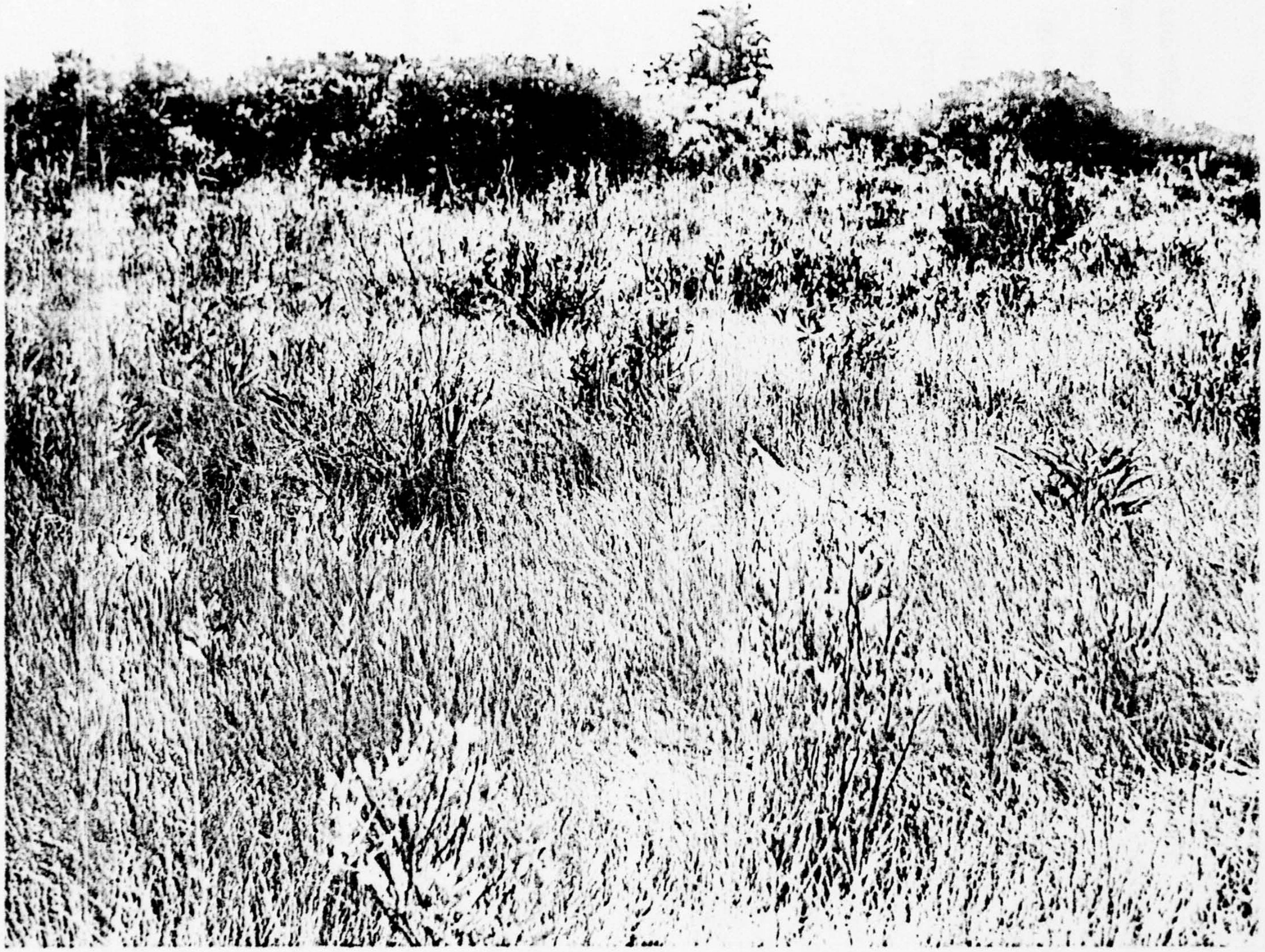

Figure 7. Shrub-dense grassland mapping unit. *Spartina patens* and *Iva frutescens* on study island 109.

dominant part. The description and data for the shrub mapping unit (notably the uplant shrub and shrub dominating *Phragmites* associations) are applicable to the shrub-forest. The only difference between the shrub and shrub-forest mapping units was the presence of scattered tree species exceeding or equalling the shrubs in stature.

61. The most commonly occurring tree species is *Juniperus virginiana*. It occurred on 10 islands, usually with fewer than five individual specimens, and standing an average of 3-4 m. tall. Occasional individuals on study islands 78B South, 98B South, and 109 attained 5.5-6 m. of height. Though shorter trees, standing less than 1.5 m. tall occurred they were not isolated on the vegetation maps but remained as incidental species within the community in which they occurred (usually shrub or shrub-*Phragmites*).

62. *Prunus serotina* occurred on four study islands (109 South, 109, 98B North and 98B South). Fewer than four specimens, generally occurred together and were 2-4 m. high.

Shrub-Dense Grassland

63. The shrub-dense grassland mapping unit is composed of an area of low shrubs standing 0.5-1.5 m. tall scattered in a grassy meadow less than 0.5 m. tall. This occurred at the dredged material deposit - high marsh interface, with high marsh vegetation composing the grassland. Old drift mats on higher spots in the intertidal marsh had a similar composition in some locations. Drift underlaid many places in the shrub-dense grassland mapping unit.

64. *Iva frutescens*, 0.5-1.5 m. high, was the dominant shrub in this mapping unit (Fig. 7). Grasses covering the ground included *Spartina patens* or *Festuca rubra* as dominants. In various locations, *Juncus gerardi* and *Distichlis spicata* were also important (25-75% cover). Other halophytes covered less than 25% of the mapping unit; *Spartina alterniflora* and *Limonium nashii* also occurred, covering less than 25% of the mapping unit.

65. At the upper levels of the mapping unit, plants associated more with upland vegetation were found. *Myrica pensylvanica* and *Baccharis halimifolia*, in shrub form, were equal to *I. frutescens* in height. *Solidago sempervirens* covered less than 25% of the ground in the upper reaches.

Figure 8. Intertidal mapping unit. High marsh, low marsh, and drift with *Iva frutescens* on study island 45A.

Intertidal

66. The intertidal areas on the vegetation maps are comprised of low salt marsh, high salt marsh, salt pannes, scattered drift, bare marsh peat, creeks and pools of water (Fig. 8). All of these are inundated by salt water during the daily or monthly high tides. The tides in this part of the Atlantic coast range from 1-1.7 m. above mean low water.

67. The low marsh is composed of *Spartina alterniflora*. It varied in height from less than 0.1 m. to nearly 1 m., but most commonly occurred at 0.15 m. in height. The most vigorous growth in the New Jersey marshes was observed in Cape May County in the vicinity of study islands 108B and 109.

68. The high marsh has a more varied flora dominated by *Spartina patens* and *Distichlis spicata*; *Atriplex patula* var. *hastata*, *Juncus gerardi*, *Salicornia europaea*, and *Limonium nashiii* are common. *Spartina alterniflora* was frequently mixed with these species, especially on the lower end of the high marsh. On the upper edges, *Phragmites communis* and *Iva frutescens* were occasionally found.

69. Salt pannes are areas generally of slightly lower elevation than the surrounding marsh. Salt water accumulates and evaporates from the pannes eventually leaving a more saline environment than even most salt marsh plants can tolerate. The salt pannes were mostly bare in the center with less than 5% cover on the edges. The most commonly occurring species here were: *Spergularia marina*, *Spartina alterniflora*, *Salicornia europaea*, *S. virginica*, and *D. spicata*.

69a. Drift mats were scattered throughout the marsh. They were sparsely vegetated by such species as: *Spartina alterniflora*, *Bassia hirsuta*, *Salicornia europaea*, and *Cakile edentula*.

70. The intertidal area extended to the interior of some study islands. The upland vegetation of study island 98A hooked around a high marsh meadow dominated by a carpet of *Spartina patens* with *D. spicata*, *L. nashii*, and *Salicornia virginica*.

71. Some intertidal areas on study islands A43a, A61c, and 78B South were separated from other intertidal regions by some upland vegetation. These were considered to the "intertidal (within deposit)" areas. Inside a

Figure 9. Dike mapping unit. *Phragmites communis* and *Solidago sempervirens* on study Island 103.

line of *I. frutescens* on study island A61c is a marsh of *D. spicata, Spartina patens,* and occasionally *Salicornia europaea,* and *L. nashii.* This high marsh surrounds a salt panne having a sparse vegetation of *Salicornia europaea* and *D. spicata.* High marsh areas on A43a and 78B South are also isolated inland. They are dominated by *Spartina patens* and *Solidago sempervirens,* with a mixture of other typical high marsh plants. These areas were within 25 m. (82 ft.) of other intertidal areas.

Dike

72. There were three diked study islands: 45A, 85C, and 103. The dikes on 45A and 85C, were about 1.5 m. tall and 1 m. across the top. The dike on 103 was in disrepair, though the northern half of the dike was about the same size as those surrounding the other deposits (Fig. 9).

73. *Phragmites communis* dominated all dikes, though it covered less than 25% of the ground area and was 0.5 - 1 m. high. More than 24 other species were also present. The most frequently occurring species included: *Atriplex patula* var. *hastata, Solidago sempervirens,* and *Spartina patens.* Each of these covered less than 50% of the ground. *Baccharis halimifolia* was occasionally found on the dikes. *Iva frutescens* and its associates generally vegetated the outer toe of the dike.

Lonicera

74. The *Lonicera* mapping unit was found only on study island 109 South. It was characterized by the dominance of *Lonicera japonica* in grasslands composed of *Achillea millefolium, Solidago altissima, Panicum lanuginosum,* and *Andropogon virginicus.* These grasslands were in transition to shrublands as evidenced by the presence of *Baccharis halimifolia* and *Rhus copallina. Partheonocissus quinquefolia* and *Rhus radicans* were other vines also common on 109 South. *L. japonica* frequently was found in blankets 1 m. deep. Where *L. japonica* was dense, only dead stems of *Phragmites communis* were found, which may indicate a dominance of *L. japonica* over *P. communis.*

Lonicera-Shrub

75. *Lonicera japonica* was found in association with shrubs *(Baccharis halimifolia* and *Rhus copallina)* on some parts of study island 109 South (Fig. 10).

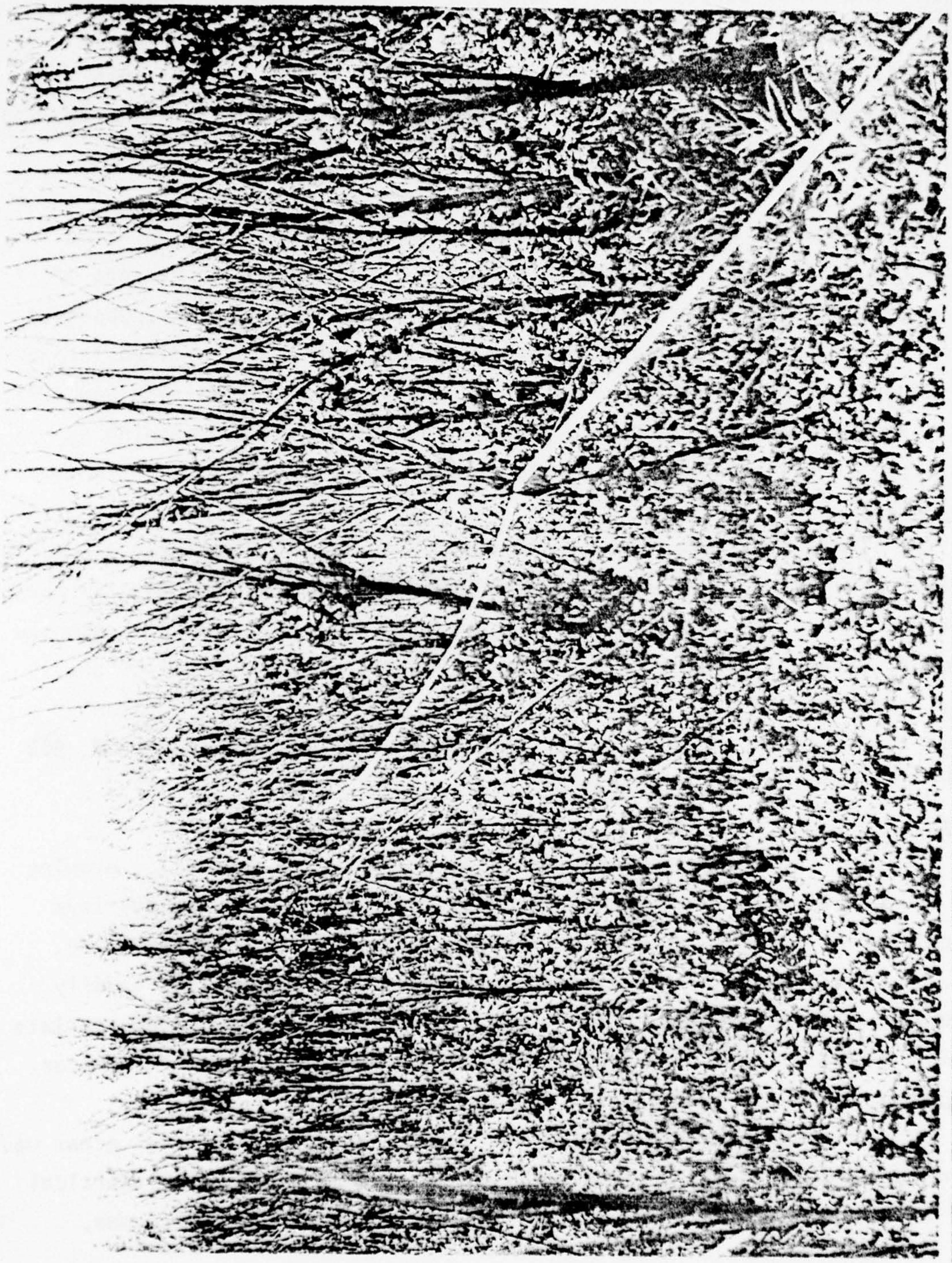

Figure 10. *Lonicera*-shrub mapping unit.
Lonicera sempervirens and *Baccharis halimifolia*.

Solidago sempervirens, Solidago altissima, and *Phragmites communis* were herbaceous members of this mapping unit. *Parthenocissus quinquefolia* was common. The vines carpeted the ground and scrambled loosely through the shrubs. The most obvious component of this mapping unit was *Baccharis halimifolia.* These shrubs were mostly dead. The exact cause of this kill is unknown, though the 1977 winter and spring, which were unusually cold, and a killing frost in May might have been the cause.

Water

76. The water mapping unit included only water located within the deposit boundary. Water outside this limit was considered to be part of the intertidal zone. The only study island, with standing water, observed during field study and on aerial imagery was 85C. This was a diked island with water impounded behind the dike. On other diked islands (45A and 103), polygons of cracked sediment were observed behind the dike, standing as evidence of earlier flooding and evaporation.

Tidal Flats

77. Tidal flats are intertidal areas of mud lacking vascular plant vegetation. They are exposed only after the tide recedes from the low marsh surface. They differed from peat exposures, in that they were not composed of compacted plant remains (peat). Aerial photos of nearly half of the study islands showed fringes of tidal flats. (Most photos were taken within several hours of low tide.) Only four study islands (X27, 98A, 98B North, 98B South), had extensive adjoining tidal flats.

Drift

78. The vegetation maps characterize drift by the vegetation growing upon it, or it is included within the intertidal mapping unit. Overlays indicating major drift locations are presented with each vegetation map.

79. Drift found within dredged material deposit boundaries usually had upland vegetation growing on it and is described within the appropriate mapping unit descriptions: sparse grassland, dense grassland, *Phragmites*, *Phragmites*-shrub, or shrub-dense grassland.

80. Drift at the interface of the deposit and the intertidal areas was described as "edge drift". This drift often accumulated on the intertidal side of the deposit where tall, stout vegetation (e.g. *Iva frutescens,*

Phragmites communis) stopped.

81. Drift scattered in the intertidal area on a distinct island or within 70 m. (200 ft.) of the deposit edge on continuous marsh areas was called "adjacent drift."

82. Drift located in the marsh or at its edge was vegetated by such species as: *Cakile edentula, Spartina alterniflora, S. patens, Distichlis spicata,* (salt-hay), *Salicornia europaea, Bassia hirsuta,* and *I. frutescens.*

PART IV: ISLAND DESCRIPTIONS

83. The twenty-one dredged material islands studied, exhibited variety in plant associations, species compositon, topography, age, and relationships to marshes, tidal flats, inlets, and upland surfaces. Descriptions of the eleven study islands that harboured colonially nesting species, are presented first, followed by ten islands, selected for vegetation analysis because they did not harbor bird colonies but did provide vegetative communities and locations of comparable nature to the other study islands.

84. Each island description is followed by a vegetation map and a drift vegetation overlay map for that island, depicting vegetation type and extent studied on that island. Tables concerned with frequency, cover, and height classes of vegetation mapping units found on each island and tables providing data on island size and areal extent of vegetation types follow the vegetation maps.

STUDY ISLAND: A12 (Ocean County)

85. A12, is a dredged material island of unknown origin, located at a latitude of 39°57' and longitude of 74°05'. It is approximately 6.5 acres in size (2.6 ha.) with a dredged material deposit approximately 5.7 acres (2.3 ha.) in size, which has created a sandy, high domed island (Fig. 11). The deposit area composed all but a thin marsh and sand fringe of the island. An elongate salt marsh island lies between A12 and cottages on the barrier beach at Ortley Beach, only 1.8 km. away. The study island is close to three marinas and receives frequent human visitation. A sandy spit on the southwestern side, and the entire western face are sites of heavy recreational use (picnicking, sun bathing, boating rest stops) from the nearby barrier beach communities.

86. Estimated elevation (2.4-3.6 m.) gives this island the highest elevation of those studied in New Jersey. The dredged material deposit predates 1969 (F. Lesser, pers. comm., June 1977, Ocean Co. Mosquito Control Comm., Barnegat, N.J.).

87. An abundance of pebble (8-20 mm.) mixed with sand and quahog shell fragments was found at the summit of the sparsley vegetated dome. The lower areas were composed mostly of sand, with approximately equal amounts of pebble and shell. A small amount of debris (cans, bottles and a 50 gallon oil drum) were randomly scattered on the dome. The western side of the island seemed to be eroding to some degree. The usual, circular, dredged material deposit shape was flattened on the west side and the sandy dome sloped down to the water's edge without the bands of marsh and upland vegetation found on the other sides.

88. The dome, which covered most of the island, was sparsely vegetated (Fig. 12). The vegetation was of low grasses: *Bromus tectorum*, *Triplasis purpurea*, *Vulpia octoflora*, *Eragrostis spectabilis?*; and herbs: *Erigeron pusillus* and *Oenothera parviflora*. The two herbs spread from a central crown. Taller herbs and grasses, *Solidago sempervirens*, *Ammophila breviligulata*, and *Phragmites communis*, occurred around the lower half of the dome and were most frequent on the eastern side (Table 1-2). Surrounding the sparse

grassland was a band of *P. communis*. Scattered *Myrica pensylvanica* and *Baccharis halimifolia* were occasionally found amongst the *P. communis*, either singly or in small thickets. A thin band of salt marsh surrounded all but the western face (Table 3).

89. A12 is characterized by an early seral stage but vegetation indicative of mid seral stages was also present.

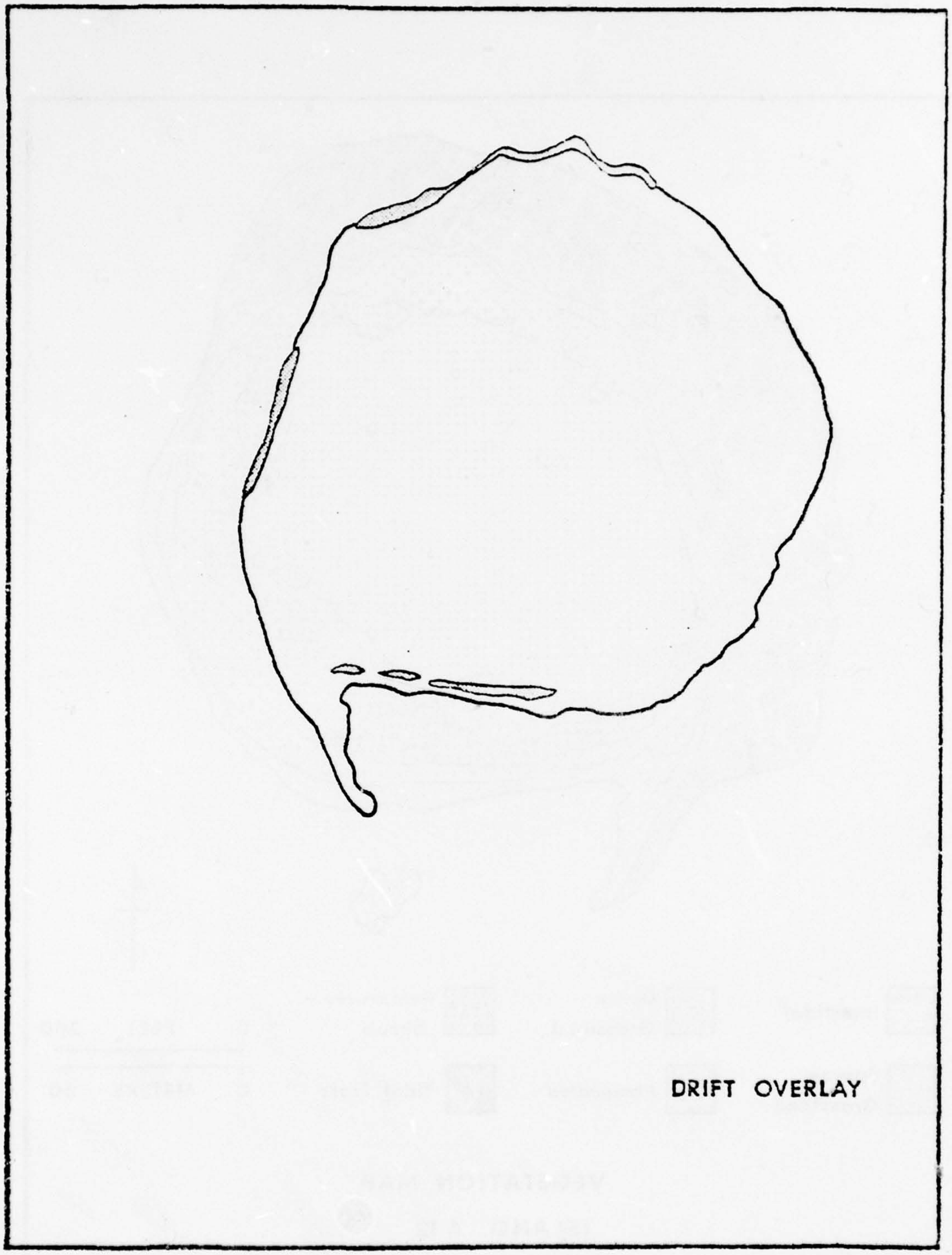

Figure 11. New Jersey dredged material island #A12 drift overlay.

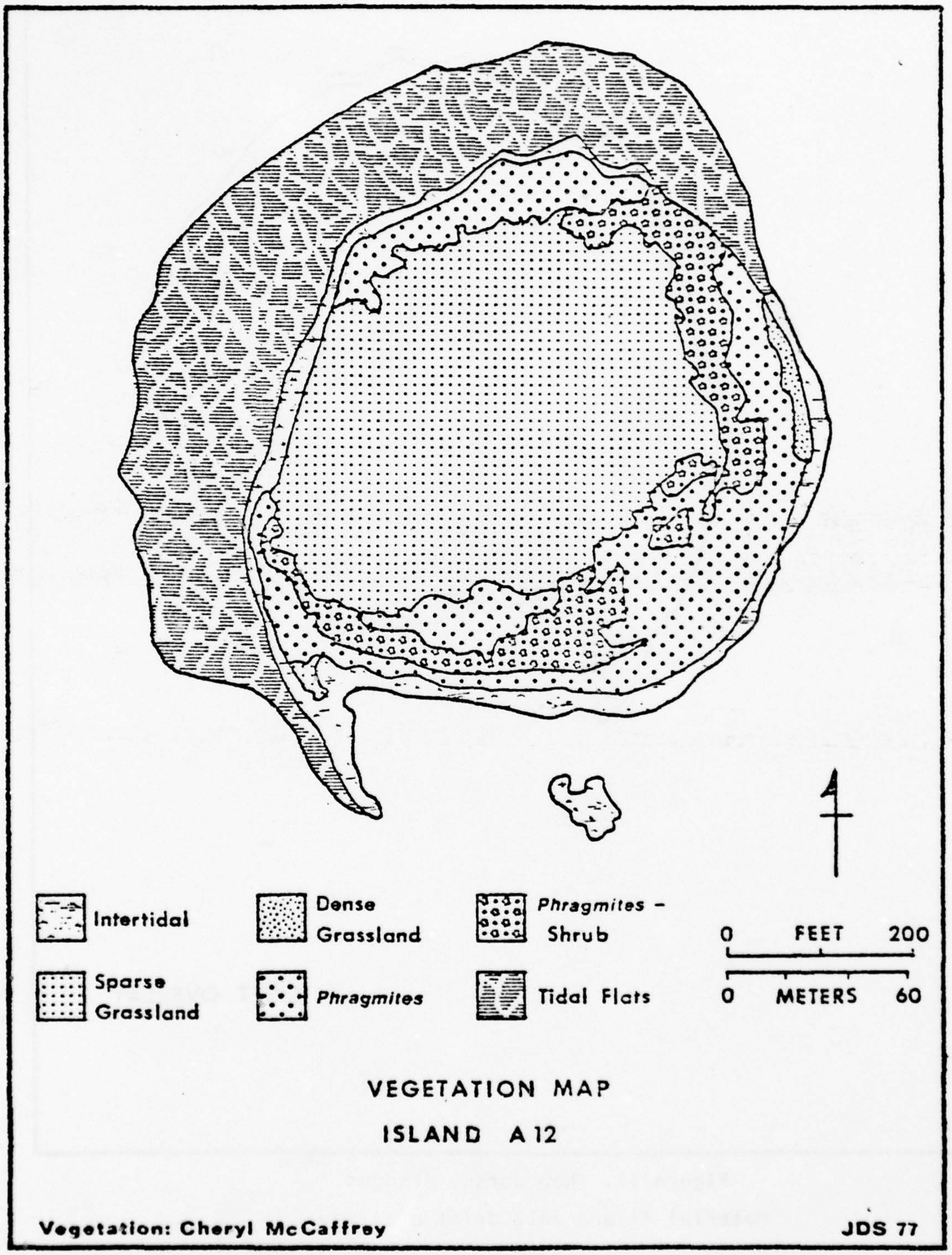

Figure 12. New Jersey dredged material island #A12 vegetation map.

TABLE 1.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A12

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SPARSE GRASSLAND								
Erigeron pusillus	3	2	2					
Bromus tectorum	2	2	2					
Triplasis purpurea	2	1	1					
Eragrostis spectablis (?)	2	2	2					
Vulpia octoflora	1	1	2					
Solidago sempervirens	1	1	2					
Phragmites communis	1	2	3					
PHRAGMITES								
Phragmites communis	4	5	5	4	4	5		
Myrica pensylvanica	3	2	3	3	1	4		
Eragrostis spectabilis (?)	3	2	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 2.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #A12

Deposit Size	5.74 Acres	2.33 Hectares	89.0% of Island
Island Size	6.45 Acres	2.61 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	3.22	1.30	56.1
Dense Grassland	0.06	0.03	1.1
Phragmites	1.56	0.63	27.1
Phragmites-Shrub	0.90	0.37	15.7
Shrub	-	-	-
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
	5.74	2.33	100.0
Drift (on deposit)	-	-	-
Non-drift deposit	5.74	2.33	100.0
	5.74	2.33	100.0

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 3.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #A12

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	0.70	0.28
Tidal Flats	3.12	1.26
Edge Drift[2]	0.12	0.05
Adjacent Drift [3]	-	-
Adjacent Units [4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: A35 (Ocean County)

90. A35 is located at a latitude of 39°41' and longitude of 74°10'. It is northwest of Surf City and about 24.1 km. north of Beach Haven Inlet. A35 is also a dredged material island of unknown origin and dredged material has not been deposited upon it since at least before 1969 (F. Lesser *ibid.*). The upland portion of the island is about 3 acres (1.2 ha.) in size and the entire island is about 6.2 acres (2.5 ha.).

91. A35 is a low island and its elevation was estimated at 1-2 meters. It is inundated during storm-high tides as evidenced by the deep drift mats and flotsam covering the interior of the island. This study island was unique, among those studied in New Jersey because of the distribution and abundance of the cordgrass and reed stem drift, not only at the interface of salt marsh and upland, but also in vast mats in varied stages of plant succession on the interior of the island. (51B had a large amount of drift, but it was not as thoroughly distributed or as open as that of A35.) High marsh vegetation, chiefly, *Spartina patens*, reaches into some interior portions of the island and has been mapped as dense grassland on the vegetation map for this island.

92. The island is dominated by *Phragmites communis* which grows densely in some places on the island. Frequently, live and dead *Myrica pensylvanica* and *Baccharis halimifolia* were found among the *Phragmites*. Several thickets of these woody species were also found here. The upland vegetation was bordered at the salt marsh by a mixture of live and dead *Iva frutescens*, which was also often mixed with *P. Communis*, *Convovulus sepium* and *Atriplex patula* var. *hastata* (Table 4).

93. Large areas of the island had exposed drift material (Tables 5-6). It ranged from bare stems and debris to about 50% cover of low herbs and grasses. The earliest invaders of the drift are *P. communis* and *Cakile edentula*. The later stages were vegetated by *Solidago tenuifolia*, *S. sempervirens*, *Convovulus sepium*, *Lepidium virginicum*, and *Strophostyles helvola* as well as *C.edentula* and *Phragmites*. *Rhus radicans* and *M. pensylvanica* were also sometimes present and represented transition into the mid seral

stage. These successional drift areas were mapped as dense grassland on the vegetation map (Fig. 14), unless characterized by a good growth of *Phragmites* in which case they were included with adjacent *Phragmites* or *Phragmites*-shrub mapping units. The extent of the drift can be seen on the drift overlay of the island (Fig. 13).

94. Vegetation on A35 was characterized by an early successional stage but portions of the island also exhibited vegetation indicative of mid and late successional stages.

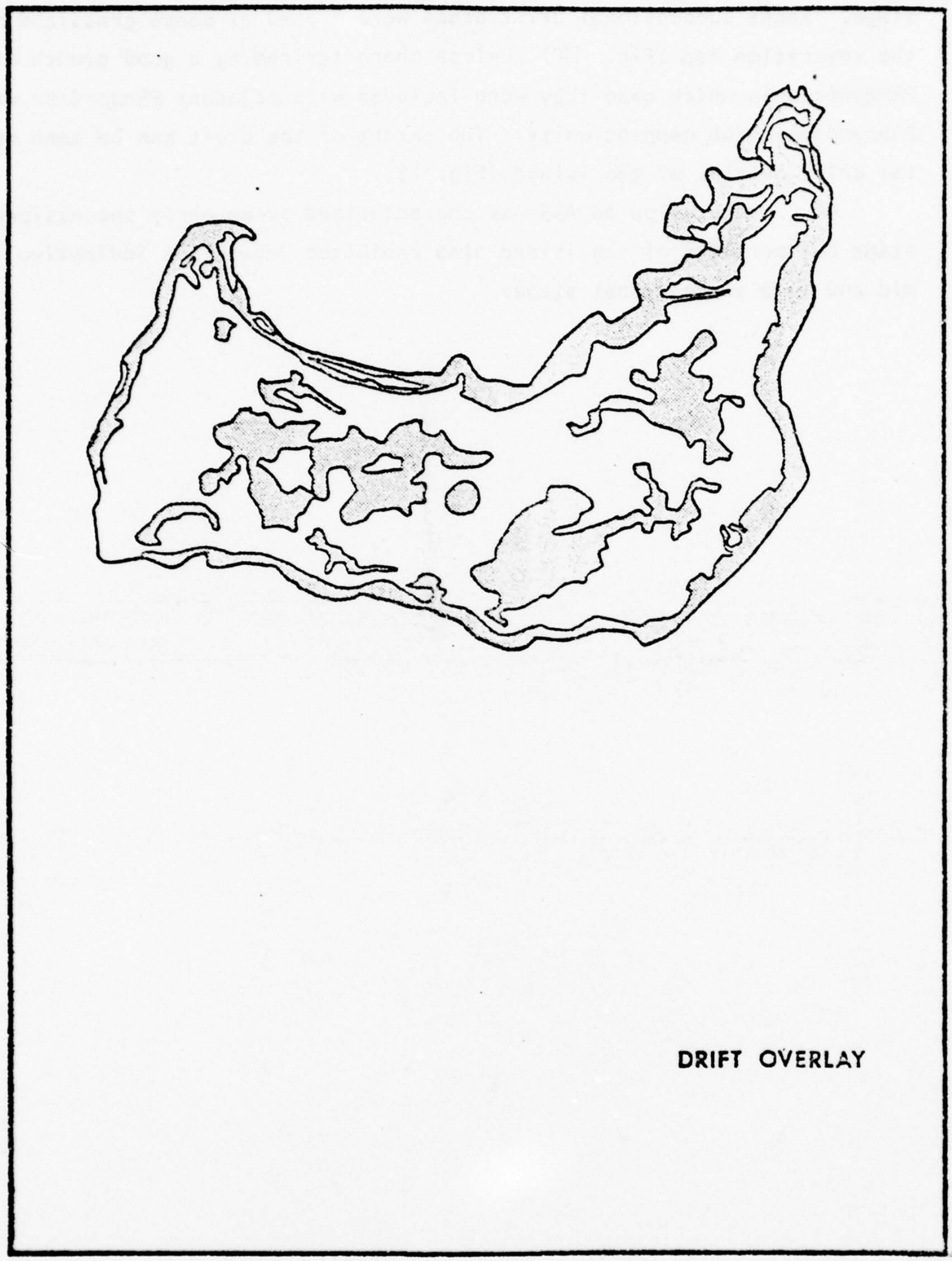

Figure 13. New Jersey dredged
material island #A35 drift overlay.

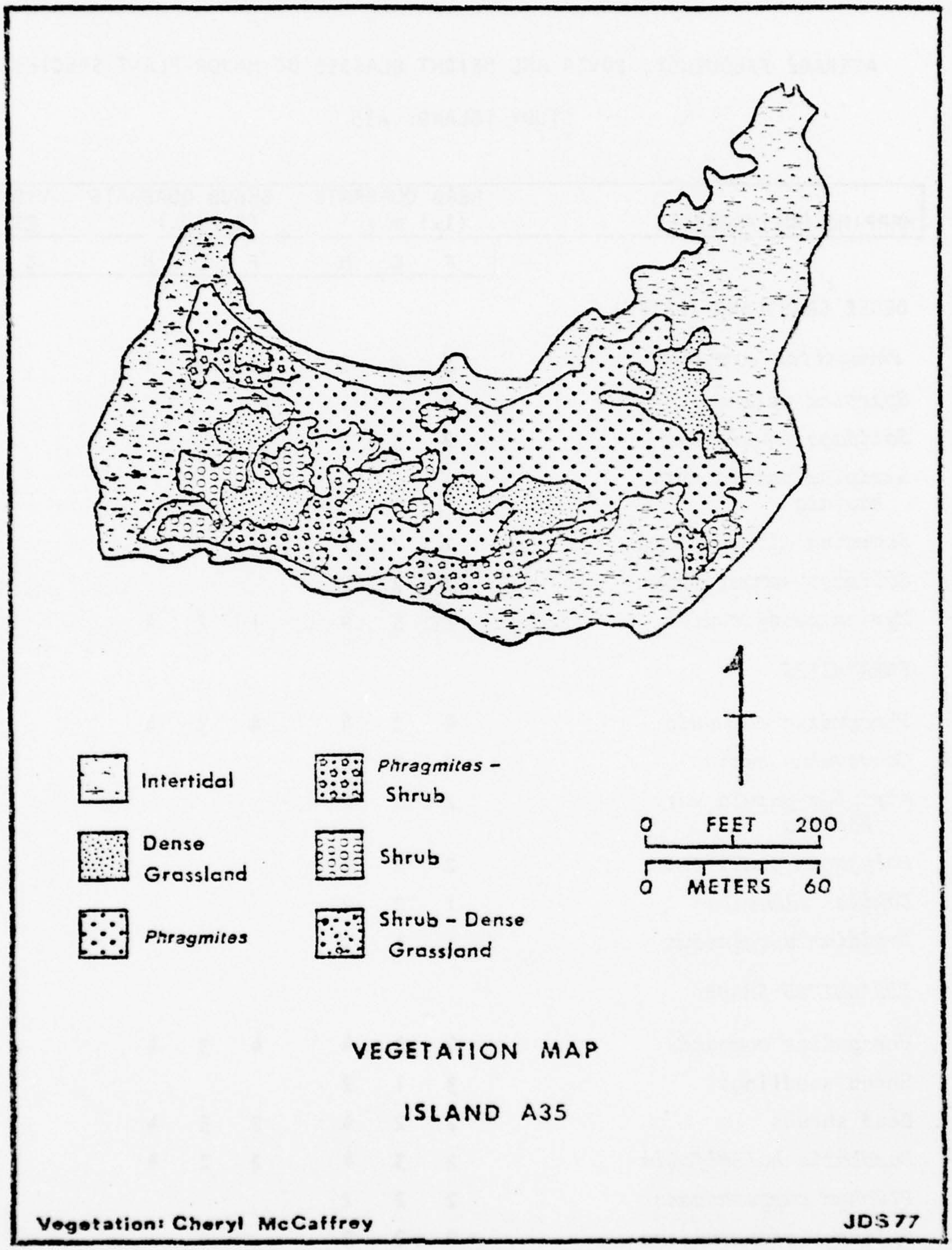

Figure 14. New Jersey dredged material island #A35 vegetation map.

TABLE 4.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A35

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
DENSE GRASSLAND (DRIFT)								
Phragmites communis	3	2	3	3	2	3		
Spartina patens	2	3	2					
Solidago tenuifolia	2	3	2					
Atriplex patula var. *hastata*	2	2	2					
Spartina alterniflora	2	2	2					
Solidago sempervirens	2	2	2					
Myrica pensylvanica	1	5	4	1	2	4		
PHRAGMITES								
Phragmites communis	4	3	4	4	3	4		
Convovulus sepium	3	2	2					
Atriplex patula var. *hastata*	2	1	2					
Polygonum punctatum	2	2	2					
Cakile edentula	1	2	2					
Lepidium virginicum	1	1	2					
PHRAGMITES-SHRUB								
Phragmites communis	4	3	4	4	3	4		
Shrub seedlings	3	1	2					
Dead shrubs	2	2	4	2	3	4		
Baccharis halimifolia	2	3	4	2	2	4		
Pluchea purpurascens	2	2	2					
Solidago sempervirens	2	2	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 4.(Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A35

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES-SHRUB (Continued)								
Spartina patens	1	3	2					
Iva frutescens	1	2	4					
SHRUB								
Iva frutescens	3	3	3	4	3	4		
Spartina patens	2	3	2					
Phragmites communis	2	2	3	2	2	4		
Myrica pensylvania	1	4	4	1	1	3		
Baccharis halimifolia	1	1	2	1	1	3		
SHRUB-DENSE GRASSLAND								
Iva frutescens	4	3	4	4	3	4		
INTERTIDAL								
Spartina alterniflora	3	3	2					
Phragmites communis	1	3	4	3	3	4		
Iva seedlings	2	2	2					
Atriplex patula var. *hastata*	2	2	2					
Spartina patens	2	3	2					
Iva frutescens	2	3	2	2	3	2		
Salicornia europaea	1	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 5.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # A35

Deposit Size	2.98 Acres	1.20 Hectares	48.38% of Island
Island Size	6.16 Acres	2.49 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.63	0.26	21.1
Phragmites	1.49	0.60	50.1
Phragmites-Shrub	0.48	0.19	16.0
Shrub	0.25	0.10	8.3
Shrub-Forest	-	-	-
Shrub-Dense Grassland	0.13	0.05	4.4
Dike	-	-	-
	2.98	1.20	99.9%
Drift (on deposit)	0.79	0.32	26.6
Non-drift deposit	2.19	0.88	73.4
	2.98	1.20	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 6.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # A35

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	3.18	1.29
Tidal Flats	-	-
Edge Drift[2]	0.35	0.14
Adjacent Drift [3]	1.07	0.43
Adjacent Units [4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

Figure 15. Aerial photo of study island 45A.

STUDY ISLAND: 45A (Ocean County)

95. 45A is a 13.8 acre (5.8 ha.) diked island located at 39°34' latitude and 74°15' longitude (Fig. 15). It is situated about 8 km. north of Beach Haven Inlet and is within 1.8 km. of cottages and marinas on the developed ocean front barrier beach. Approximately half of the island (6.3 acres) is dredged material, the remainder is salt marsh. The last dredged material deposition on the island was in 1976. The actual extent of the most recent deposition is uncertain but probably did not include the center of the island. Inside the dike, the deposition had a gradual slope with a slight summit, approximately 1 meter in elevation (Fig. 16).

96. The dike is roughly 1-1/2 m. tall and one meter wide at the top. It had a varied flora dominated by *Phragmites communis*, and included *Festuca rubra, Spartina patens, Solidago sempervirens, Atriplex patula* var. *hastata*, and *Convovulus sepium* (Fig. 17).

97. Inside the dike was a band of bare sand and shell (whole and fragmented). Advancing *Phragmites* culms and an occasional dead shrub protruded from the sand. The southern end of this bare area, had slightly more vegetation than the northern end (though still considered to be very sparse *Phragmites*) (Table 7). It also had a little more debris in the form of lumber than the northern end and the surface had several areas with irregular relief, which was lacking at the other end. Cracked clay was evident near a pipe which pierced the dike.

98. At the center of the island was a dense grassland dominated by *Spartina patens*. *Solidago sempervirens, Cirsium arvense* and *Apocynum cannabinum* were abundant here with scattered *Myrica pensylvanica, Baccharis halimifolia*, and *P. communis* (Tables 8-9). Sand, clay, and whole shells were found beneath the grasses. Between the grassy center and the bare area was a solid stand of *Phragmites communis* about 1-1/2 m. in height.

99. A short row of black pine seedlings were planted in 1976 by a local cub scout troop, inside the dike, but were somewhat moribund in 1977.

100. Vegetation on this island was characteristic of an early seral stage.

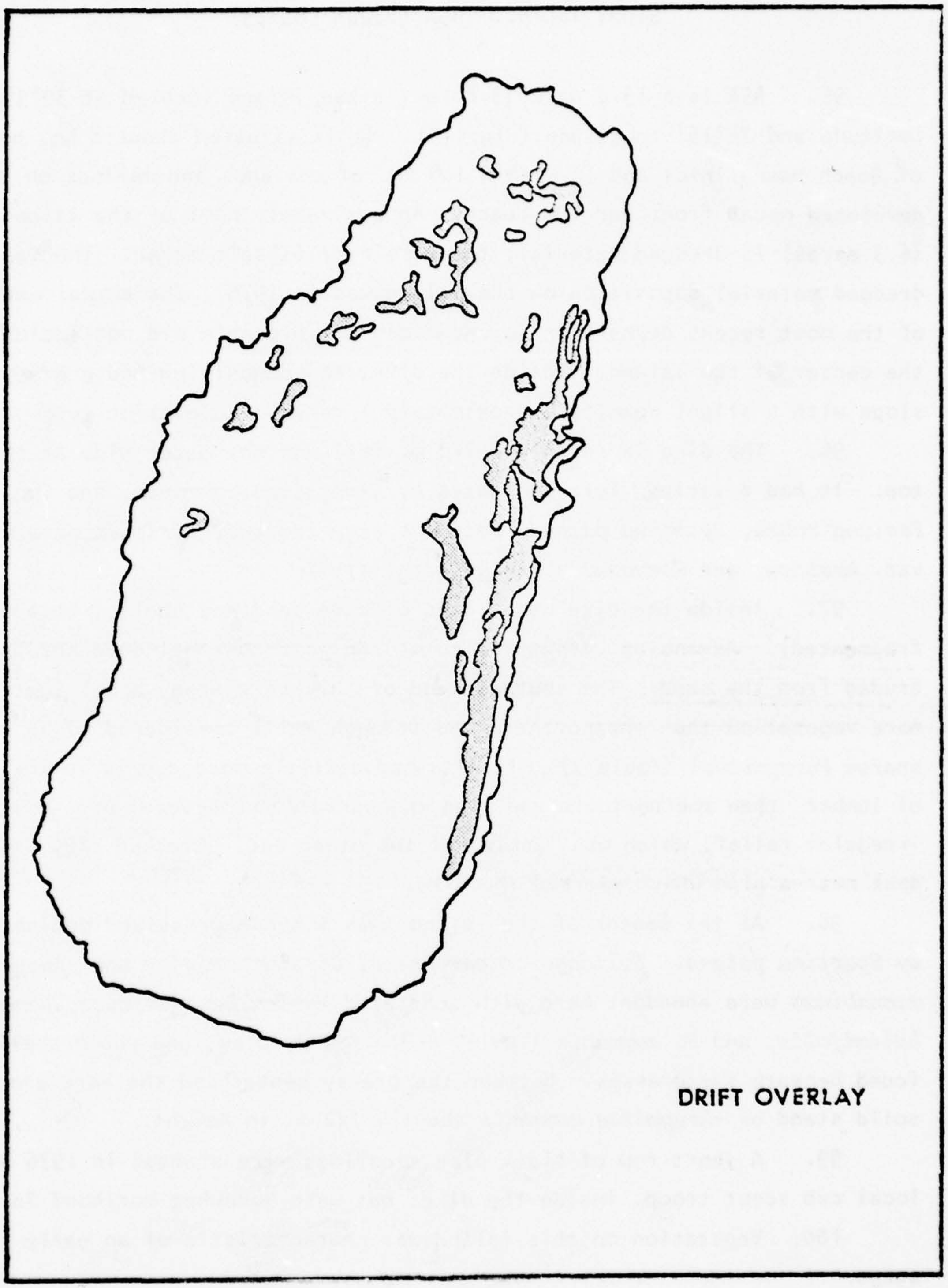

Figure 16. New Jersey dredged material island #45A drift overlay.

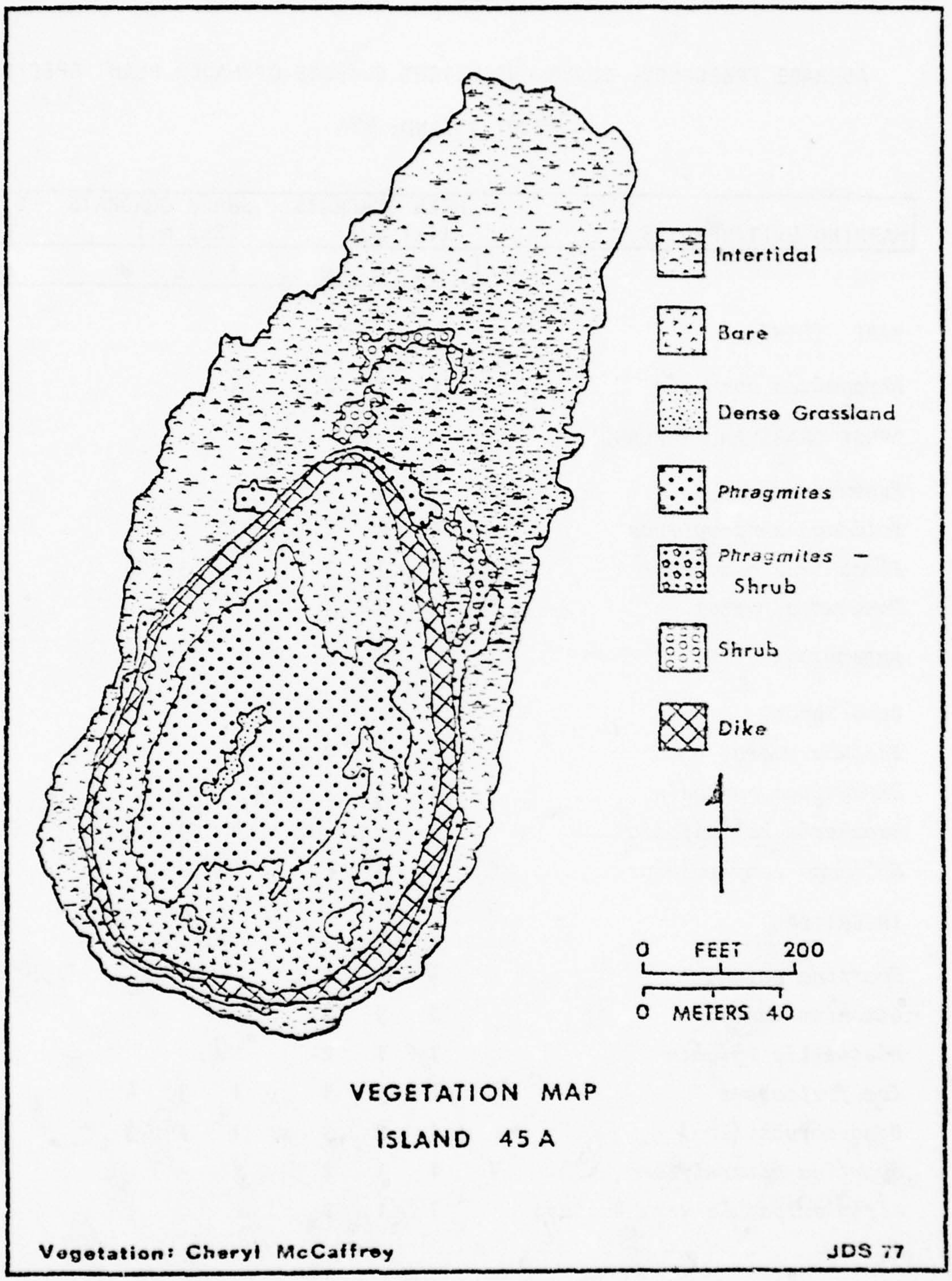

Figure 17. New Jersey dredged material island #45A vegetation map.

TABLE 7.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 45A

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
BARE (DIKE)								
Phragmites communis	1	1	2					
DENSE GRASSLAND (UPLAND)								
Festuca rubra	4	5	2					
Solidago sempervirens	4	2	2					
Phragmites communis	4	2	3	4	3	4		
Panicum virgatum	2	2	3					
PHRAGMITES								
Dead Shrubs	4	4	4					
Festuca rubra	4	4	2					
Phragmites communis	4	2	3					
Baccharis halimifolia	-	-	-	4	3	3		
Solidago sempervirens	4	1	2					
INTERTIDAL								
Spartina patens	4	4	2					
Limonium nashii	2	3	2					
Distichlis spicata	1	1	2					
Iva frutescens	1	3	3	1	3	4		
Dead shrubs (*Iva*)	1	2	3	1	1	3		
Spartina alterniflora	1	1	2					
Atriplex patula var. *hastata*	1	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 7. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 45A

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
DIKE								
Phragmites communis	4	3	3					
Spartina patens	2	3	2					
Atriplex patula var. *hastata*	1	2	2					
Solidago sempervirens	1	2	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 8.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 45A

Deposit Size	6.31 Acres	2.56 Hectares	45.82% of Island
Island Size	13.77 Acres	5.57 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	3.00	1.22	47.6
Sparse Grassland	-	-	-
Dense Grassland	0.04	0.02	0.6
Phragmites	2.41	0.97	38.1
Phragmites-Shrub	-	-	-
Shrub	-	-	-
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	0.86	0.35	13.6
	6.31	2.56	99.9%
Drift (on deposit)	0.01	<0.01	0.1
Non-drift deposit	6.30	2.56	99.9
	6.31	2.56	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 9.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 45A

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.74	2.73
Tidal Flats	-	-
Edge Drift[2]	0.39	0.16
Adjacent Drift[3]	0.50	0.20
Adjacent Units[4] (total)	0.72	0.30
Bare	0.06	0.03
Phragmites-Shrub	0.07	0.03
Shrub	0.14	0.06
Phragmites	0.45	0.18

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: X27 (Ocean County)

101. X27, located at 39°32' latitude and 74°17' longitude, is about 3.2 km. north of Beach Haven Inlet. The entire island is 32.6 acres (13.2 ha.) in size and is mostly salt marsh. At low tide, extensive tidal flats surround the island. The dredged material deposition measured only 1.7 acres (0.7 ha.) and was in an elongate configuration on the northeastern side of the island. The dredged material deposit is of unknown origin and pre-dates 1969 (F. Lesser, pers. comm.). The central ridge of the deposit was composed of sand and shell and was exposed on some parts of the ridge. Elevation of the area was estimated at 1.5 meters but the presence of drift on the ridge, indicates some storm tide inundation (Fig. 18).

102. The study island was composed of two connected areas. One, continously elongate from south to north, was chiefly dense grassland on the higher portions with a shrub thicket between it and the salt marsh (Fig. 19) The second area was a dome on the northern end of the upland portion of the island. It was chiefly dense grassland, though rather sparse on top. A border of *Iva frutescens* occurred at many places where the upland met the salt marsh (Table 10).

103. The grassland on the south central portion was dominated by *Ammophila breviligulata, Lepidium virginicum* and *Achillea millefolium.* On the western side of the grassland, was a shrub thicket with 2-4 meter high *Baccharis halimifolia* and shorter *I. frutescens* with abundant *Lactuca biennis* (?) beneath. The shrub thicket on the east was dominated by *B. halimifolia* and *Rhus radicans*, with *L. biennis(?)* and *A. millefolium* in the herb layer. Further to the south, patches of *I. frutescens* met the dense grassland areas. On the northernmost end of the deposit area, the grassland was composed of *L. virginicum, A. millefolium, A. breviligulata, Cirsium arvense, Solidago sempervirens,* and *Lathyrus japonicus. I. frutescens* and *B. halimifolia* separated the grassland from the high marsh (Tables 11-12).

104. Vegetation on this island was characteristic of a late seral stage but early and mid seral stage vegetation was also present.

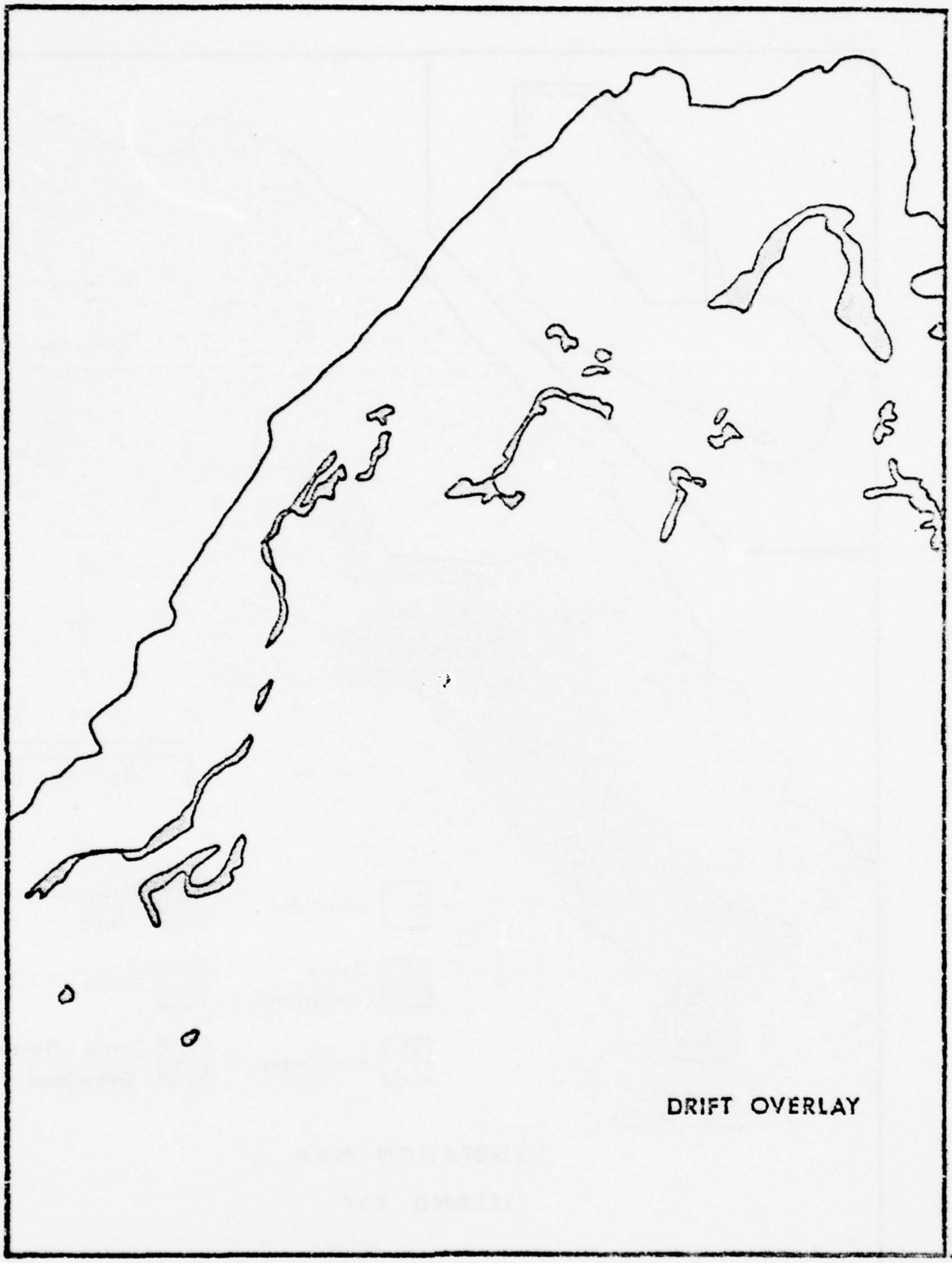

Figure 18. New Jersey dredged material island #X27 drift overlay.

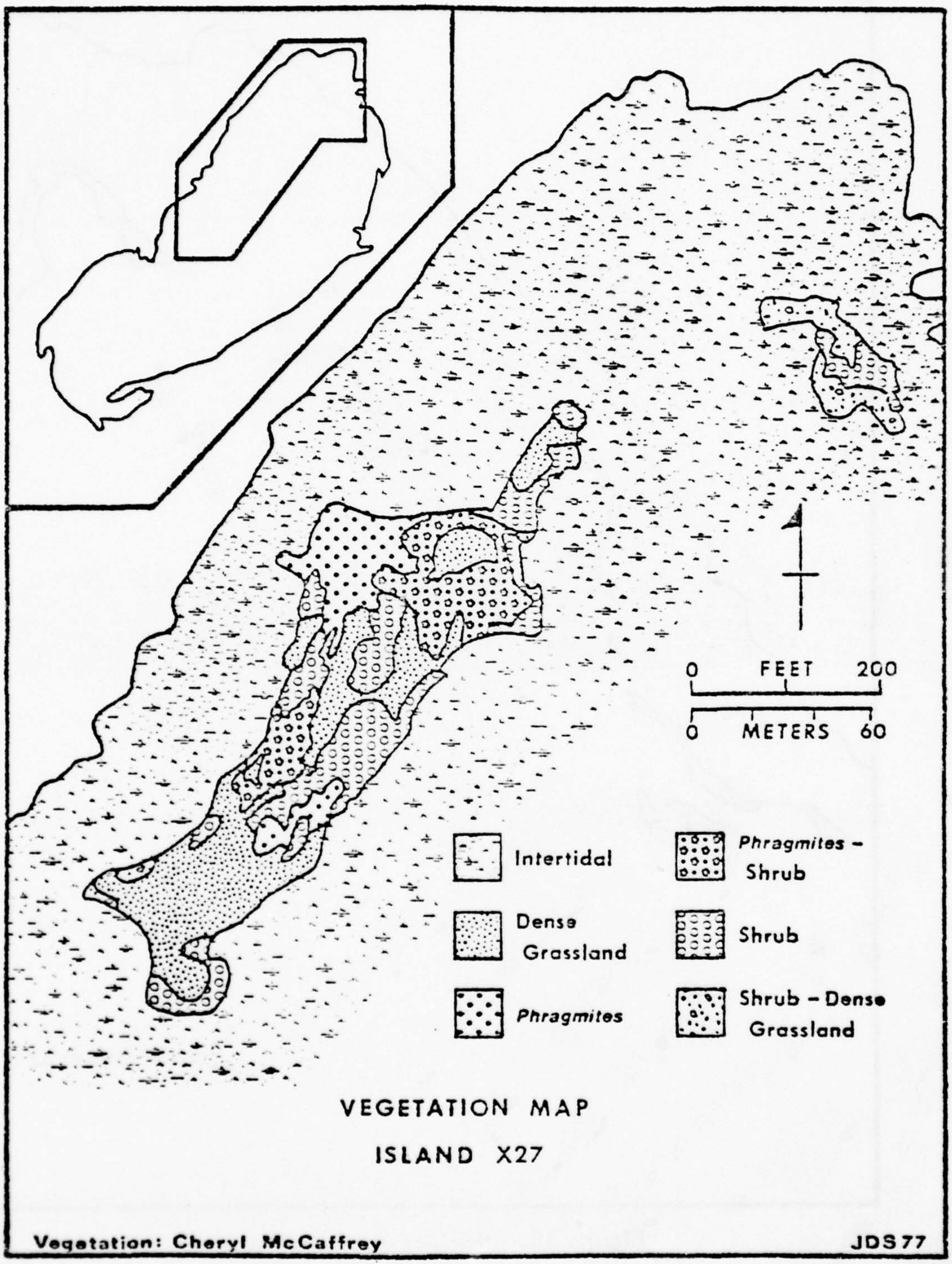

Figure 19. New Jersey dredged material island #X27 vegetation map.

TABLE 10.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: X27

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
DENSE GRASSLAND (UPLAND)								
Ammophila breviligulata							3	2
Lathyrus japonicus							3	2
Lepidium virginicum							3	2
Achillea millefolium							2	2
Chenopodium ambrosioides							2	2
Iva frutescens							2	4
Lactuca sp.							2	3
Solidago sempervirens							2	3
PHRAGMITES								
Phragmites communis							5	5
PHRAGMITES-SHRUB								
Baccharis halimifolia							5	2
Iva frutescens							5	2
Phragmites communis							5	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 10. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: X27

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB								
Iva frutescens							5	4
Spartina patens							5	2
Baccharis halimifolia							4	4
Rhus radicans							4	4
Dead shrubs							3	5
Lactuca sp.							3	4
Myrica pensylvanica							2	5
Phragmites communis							2	4

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 11.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #X27

Deposit Size	1.69 Acres	0.68 Hectares	5.18% of island
Island Size	32.64 Acres	13.21 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.72	0.29	42.7
Phragmites	0.29	0.12	17.2
Phragmites-Shrub	0.37	0.15	22.1
Shrub	0.30	0.12	17.6
Shrub-Forest	-	-	-
Shrub-Dense Grassland	0.01	< 0.01	0.4
Dike	-	-	-
	1.69	0.68	100.0%
Drift (on deposit)	0.03	0.01	1.5
Non-drift deposit	1.66	0.67	98.5
	1.69	0.67	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 12.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # X27

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	30.78	12.45
Tidal Flats	4.34	1.76
Edge Drift[2]	-	-
Adjacent Drift[3]	-	-
Adjacent Units[4] (total)	0.18	0.07
Shrub-Dense Grassland	0.12	0.05
Shrub	0.06	0.02

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

Figure 20. Aerial photo of study island A61c.

STUDY ISLAND: A61c (Atlantic County)

105. A61c, located at 39°24' latitude and 74°26' longitude is about 3.2 miles northwest of Absecon Inlet (Fig. 20). Island size is approximately 13.58 acres (5.50 ha.) in size with an 8.6 acre extent of dredged material over about half of it. The island is surrounded by extensive salt marshes. The date of the last dredged material deposition is unknown, but is probably also prior to 1969 (Fig. 21).

106. The island has little topographic relief and was dominated by a large stand of 2.4 meter high *Phragmites communis*. Live and dead *Baccharis halimifolia* were scattered throughout the *Phragmites*. *Solidago sempervirens* and *Lepidium virginicum* were common in places beneath the reed. On the eastern side of the dredged material was an arc which had a lower vegetative cover. Aerially, it appeared to be a ridge vegetated by grasses, *P. communis* and scattered *Myrica pensylvanica* (Fig. 22). (Extensive ground truthing was not conducted on A61c because of the density of wading bird nests.) Some of the outer parts of the dredged material had 1.5-3.6 meter high shrub thickets, composed mostly of *M. pensylvanica*, *B. halimifolia*, and *Iva frutescens* with an abundance of *Atriplex patula* var. *hastata* and *P. communis* (Tables 13-14).

107. On the western side of the island nearest the Intracoastal Waterway, the vegetation was more marsh related. The upper part of the salt marsh was bordered by *I. frutescens* with *Juncus gerardi*, *Festuca rubra*, and *Distichlis spicata* carpeting most of the ground. Drift mats were also present in this area (Table 15).

108. Between the *Iva* and the *Phragmites* was an arc of essentially bare salt panne surrounded by high marsh composed chiefly of *D. spicata* and *J. gerardi*. In one location there was a ridge, about one-half meter above the marsh surface, vegetated by a 3.6 m. high shrub thicket, dominated by *M. pensylvanica* and *I. frutescens* with scattered *P. communis*. The herb layer consisted of *A. patula* var. *hastata*, *D. spicata*, *S. patens* and *Chenopodium album*.

109. This island was characterized by early seral stage vegetation, but mid and late seral stage vegetation was also present.

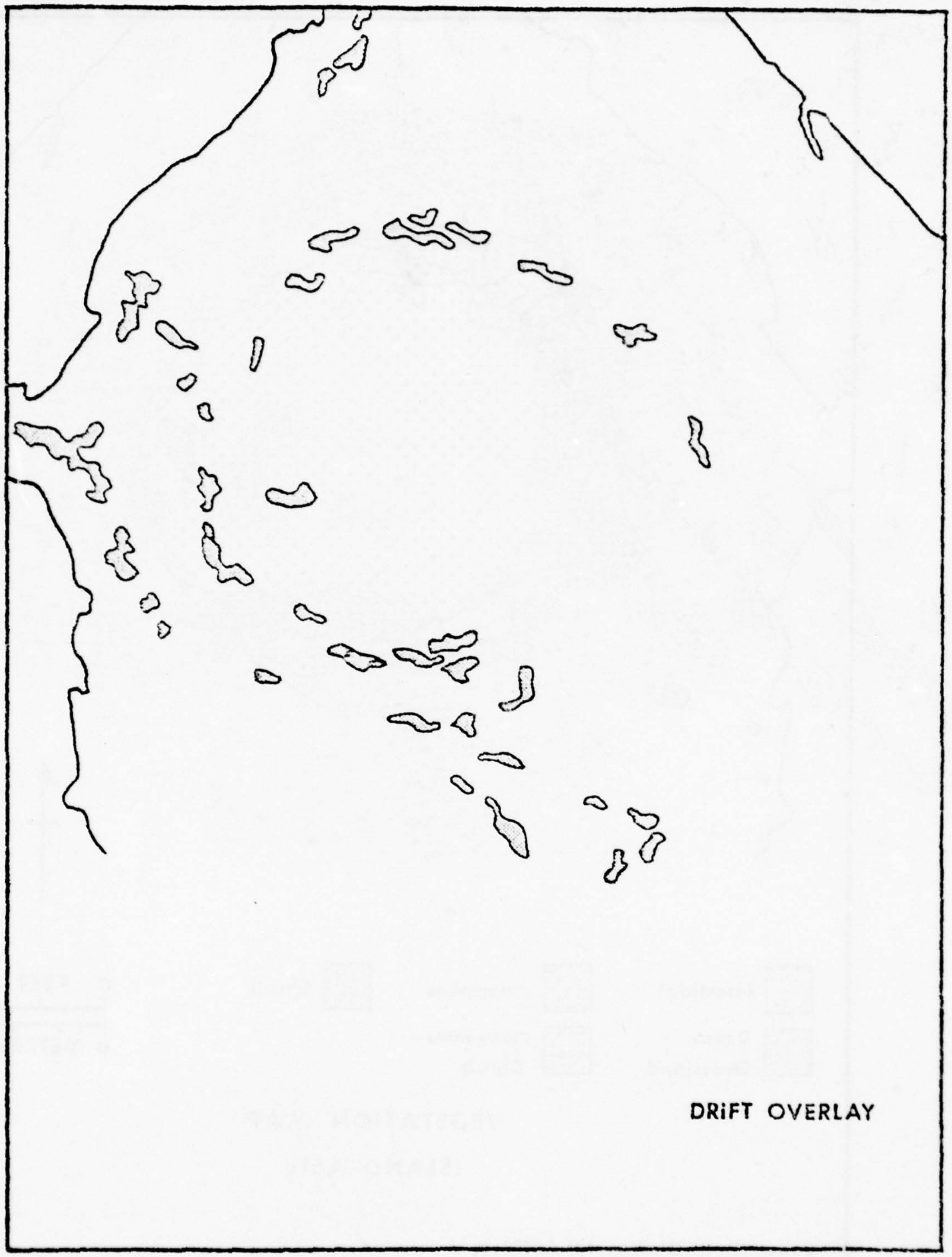

Figure 21. New Jersey dredged material island #A61c drift overlay.

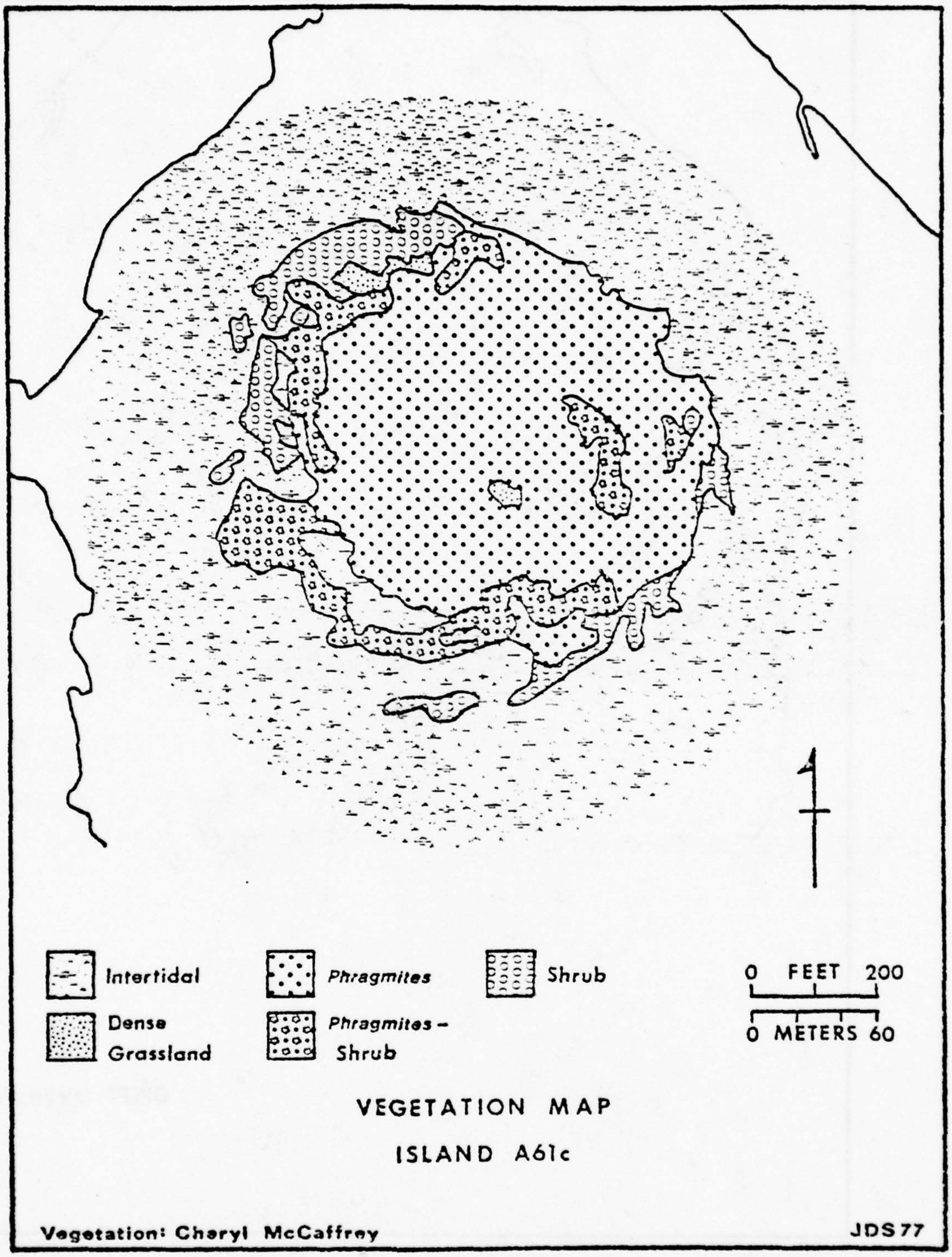

Figure 22. New Jersey dredged material island #A61c vegetation map.

TABLE 13.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES
STUDY ISLAND: A61c

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB								
Iva frutescens	4	4	4	4	3	4		
Iva seedlings	3	2	2					
Juncus gerardi	2	5	2					
Atriplex patula var. *hastata*	2	3	3					
Distichlis spicata	2	1	2					
Myrica pensylvanica	-	-	-	2	3	5		
Baccharis halimifolia	1	2	2	2	1	4		
Rhus radicans	-	-	-	1	2	5		
INTERTIDAL								
Distichlis spicata	4	4	2					
Spartina alterniflora	3	3	2					
Salicornia europaea	2	2	2					
Atriplex patula var. *hastata*	1	1	2					
Spartina patens	1	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 14.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # A61c

Deposit Size	8.60 Acres	3.48 Hectares	63.33% of Island
Island Size	13.58 Acres	5.50 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.12	0.05	1.4
Phragmites	5.62	2.27	65.4
Phragmites-Shrub	1.50	0.61	17.4
Shrub	1.01	0.41	11.7
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
Intertidal (within deposit)	0.35	0.14	4.1
	8.60	3.48	100.0%

Drift (on deposit)	0.24	0.10	2.75
Non-drift deposit	8.36	3.38	97.2%
	8.60	3.48	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 15.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # A61c

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	14.82 +	6.00 +
Tidal Flats	-	-
Edge Drift[2]	0.12	0.05
Adjacent Drift [3]	0.35	0.14
Adjacent Units [4]	-	-

1. Plant communities occurring outside the deposit boundary on the island;
2. Drift located at the interface of the deposit and the intertidal;
3. Drift scattered in the intertidal area well beyond the deposit boundary;
4. Mapping Units separated from the deposit within the intertidal area.

Figure 23. Aerial photo of study island 85dmi.

STUDY ISLAND: 85dmi (Cape May County)

110. 85dmi, located at 39°13' latitude and 74°39' longitude, is northwest of Corson Inlet and south of the junction of Beach Creek and Weakfish Creek (Fig. 23). It is a salt marsh area which had dredged material deposited upon it in 1966 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District. The dredged material deposit area is approximately 6 acres (2.4 ha.) in size and surrounded by extensive salt marsh. Houses on the barrier beach are nearby. The area has little topographic relief (Fig. 24).

111. Most of the dredged material deposit area was vegetated by shrubs and *Phragmites communis*. A wide belt of *Iva frutescens* with a herb layer of *Spartina patens*, *Festuca rubra* and several other plants including some halophytes was present. The northwestern tip of the dredged material was dominated by *P. communis*. In many places shrubs mingled with the *Phragmites*. These included 2-4 meter high *Myrica pensylvanica*, *Rhus radicans* and a small amount of *Sambucus canadensis*, *Baccharis halimifolia* and *Juniperus virginiana* (Fig. 25).

112. On the marsh side, *I. frutescens* was associated with the *P. communis*. Here *Juncus gerardi* and *S. patens* formed the ground cover. There were some areas in which the shrubs dominated the *Phragmites*, and in others the reverse was true. Besides the *Phragmites*-shrub associations, the shrub thicket itself was very important. This included *M. pensylvanica*, *B. halimifolia*, *I. frutescens*, occasional *J. virginiana* and some 1-2 m. high *P. communis* (Tables 16-17).

113. Vegetation on this island was characteristic of a late seral stage but early and mid seral stage vegetation was also present (Table 18).

Figure 24. New Jersey dredged material island #85dmi drift overlay.

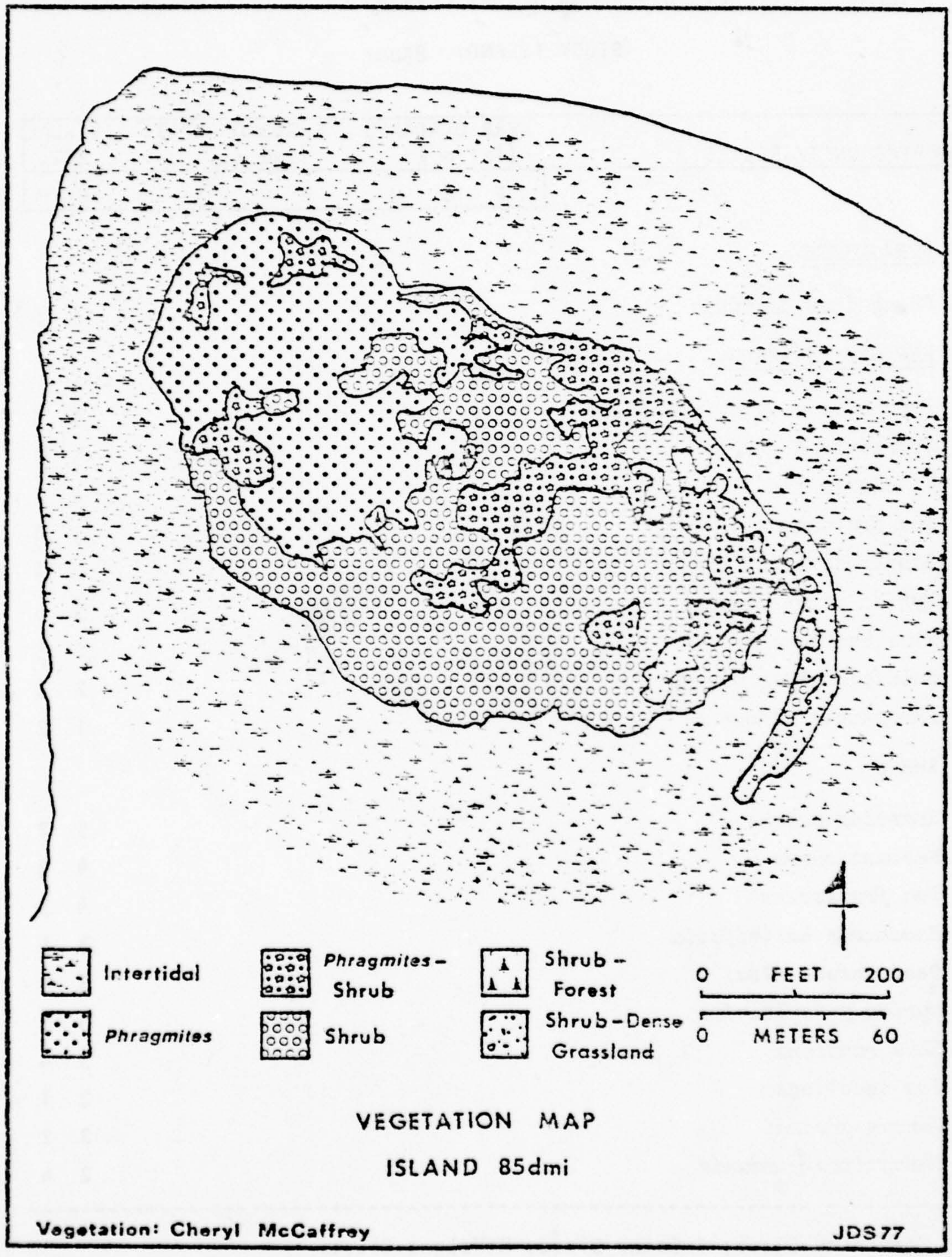

Figure 25. New Jersey dredged material island #85dmi vegetation map.

TABLE 16.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 85dmi

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES								
Phragmites communis							5	5
PHRAGMITES-SHRUB								
Parthenocissus quinquefolia							5	5
Spartina patens							5	2
Juncus gerardi							4	2
Iva frutescens							3	4
Baccharis halimifolia							2	4
Myrica pensylvanica							2	5
Rhus radicans							2	5
Solidago sempervirens							2	2
Phragmites communis							1	2
SHRUB								
Spartina patens							5	2
Festuca rubra							4	2
Iva frutescens							4	3
Baccharis halimifolia							3	5
Dead shrubs *(Iva)*							3	3
Myrica pensylvanica							3	5
Rhus radicans							3	4
Iva seedlings							2	1
Juncus gerardi							2	2
Phragmites communis							2	4

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 16.(Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 85dmi

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
INTERTIDAL								
Spartina patens							5	2
Distichlis spicata							2	2
Salicornia bigelovii							2	2
Salicornia europaea							2	2
Spartina alterniflora							2	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 17.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 85dmi

Deposit Size	5.90 Acres	2.38 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	1.67	0.68	28.3
Phragmites-Shrub	1.02	0.41	17.3
Shrub	2.82	1.14	47.8
Shrub-Forest	0.01	< 0.01	0.2
Shrub-Dense Grassland	0.38	0.15	6.4
Dike	-	-	-
	5.90	2.38	100.0%
Drift (on deposit)	0.38	0.15	6.4
Non-drift deposit	5.52	2.23	93.6
	5.90	2.38	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 18.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 85dmi

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	10.31 +	4.17 +
Tidal Flats	-	-
Edge Drift[2]	0.15	0.06
Adjacent Drift[3]	0.09	0.04
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 98A (Cape May County)

114. 98A, located at 39°05' latitude and 74°46' longitude, is about 6 km. southwest of Townsend's Inlet and 6.4 km. northwest of Hereford Inlet. Island size is approximately 14.7 acres (6 ha.) and the dredged material covers about 2 acres (0.77 ha.) of it (Fig. 26). The last known dredged material deposition upon this island occurred in 1968 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District. The upland part of the island has little topographic relief (Fig. 27) and is somewhat elliptical in shape as discerned from aerial photographs of the island.

115. The western side of this ellipse was mostly high marsh dominated by a lush carpet of *Spartina patens* and *Distichlis spicata* surrounded by a ring of daily high tide drift. On the upper end of the high marsh, drift left by spring tides or storm flooding rested at the border of shrub communities and the high marsh. This high marsh hooked in between two rows of shrubs (Tables 19-20).

116. *Iva frutescens* grew in the high marsh and upon the drift, forming the outer border of dredged material uplands with the marsh on the western side. On the eastern side, a 1-3 meter high *Phragmites*-shrub association dominated. *Phragmites communis*, *Myrica pensylvanica* and *Baccharis halimifolia* are the most common members of this association. On the marsh side, and still within this community, *I. frutescens* was an important component. A small area of *Myrica* - *Baccharis* shrub thicket was located on the southeast. Another small shrub thicket containing one 2.4 high *Juniperus virginiana* was centrally located near the "hook" of the high marsh (Table 21).

117. A mid seral stage characterized the vegetation on this island, but early and late seral stages were also present.

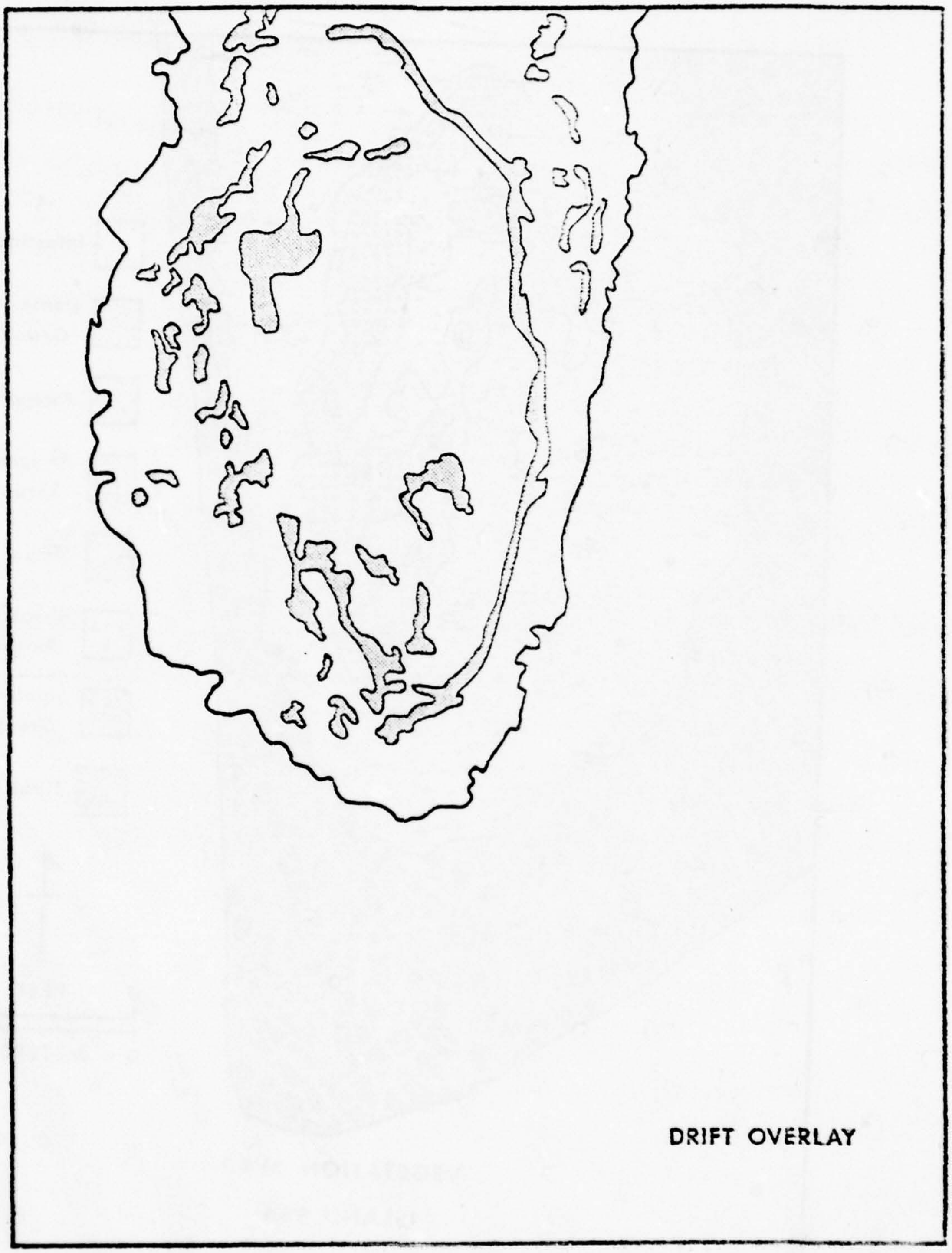

Figure 26. New Jersey dredged material island #98A drift overlay.

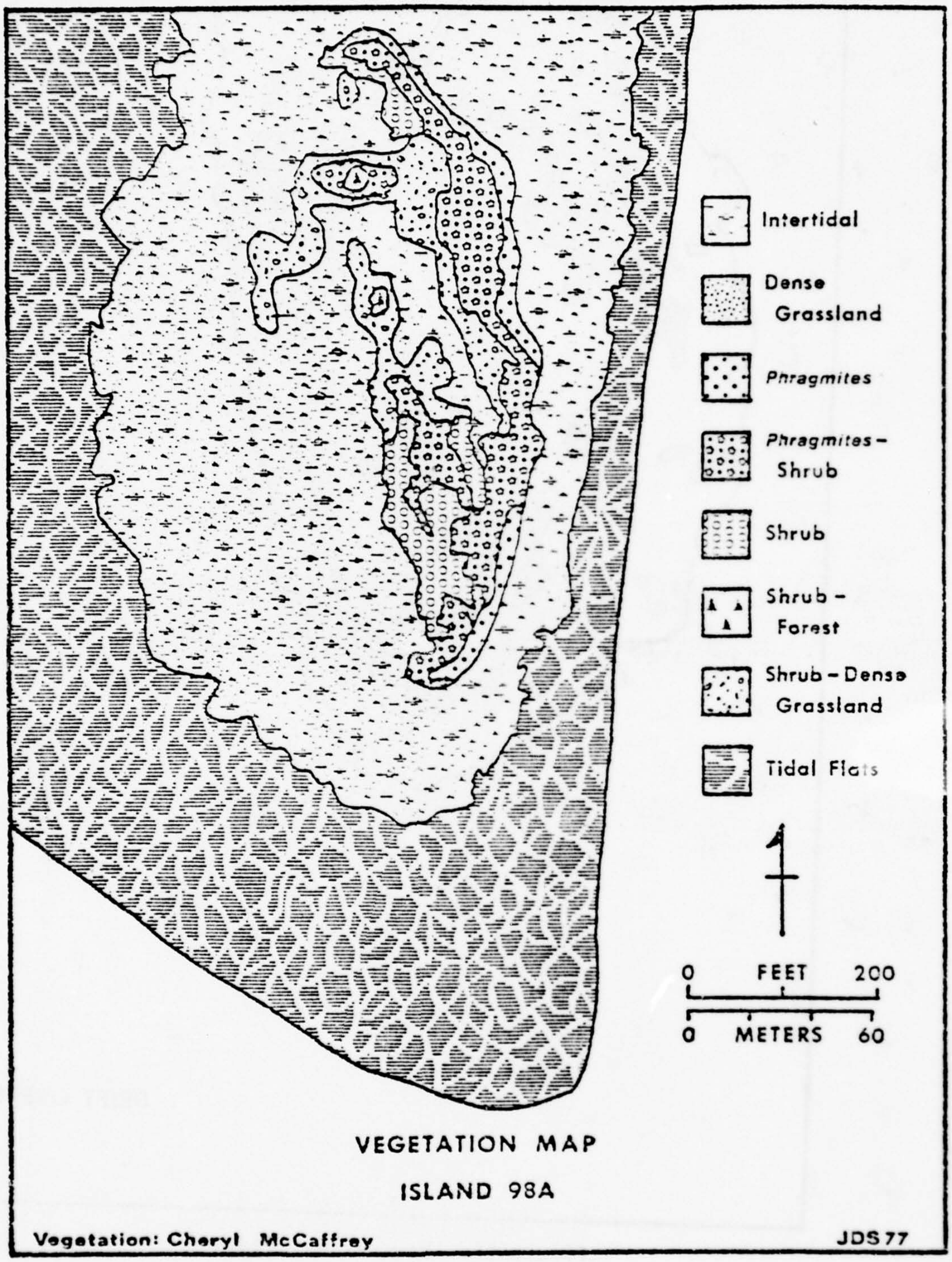

Figure 27. New Jersey dredged material island #98A vegetation map.

TABLE 19.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98A

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES								
Phragmites communis							5	4
Atriplex patula var. *hastata*							2	2
Iva frutescens							2	2
PHRAGMITES-SHRUB								
Iva frutescens							4	3
Phragmites communis							4	4
Atriplex patula var. *hastata*							2	2
Baccharis halimifolia							1	4
Juniperus virginiana							2	5
Myrica pensylvanica							2	4
Solidago sempervirens							2	2
Spartina patens							2	2
Suaeda linearis							2	2
SHRUB								
Iva frutescens							4	4
Myrica pensylvanica							4	5
Festuca rubra							3	2
Baccharis halimifolia							3	4
Juncus gerardi							3	2
Phragmites communis							3	4
Rhus copallina							2	5
Spartina patens							2	2
Rhus radicans							1	3

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 19. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98A

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
INTERTIDAL								
Spartina patens							5	2
Distichlis spicata							3	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 20.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 98A

Deposit Size	1.89 Acres	0.77 Hectares	12.90% of Island
Island Size	14.65 Acres	5.93 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.02	0.01	1.0
Phragmites	0.20	0.08	10.7
Phragmites-Shrub	0.74	0.30	39.1
Shrub	0.34	0.14	17.7
Shrub-Forest	< 0.01	< 0.01	0.3
Shrub-Dense Grassland	0.59	0.24	31.1
Dike	-	-	-
	1.89	0.77	99.9%
Drift (on deposit)	0.18	0.07	9.4
Non-drift deposit	1.71	0.70	90.6
	1.89	0.77	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 21.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 98A

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	12.76	5.16
Tidal Flats	12.51 +	5.06 +
Edge Drift[2]	0.32	0.13
Adjacent Drift[3]	0.39	0.16
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 98B North (Cape May County)

118. 98B North, located at 39°05' latitude and 74°47' longitude, is about 6 km. southwest of Townsend's Inlet and 6.4 km. northwest of Hereford Inlet (Fig. 28). The dredged material deposit area is about 1.16 acres (0.46 ha.) and was last deposited upon in 1968 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District. There is little topographic relief on the area, which is also surrounded by mud flats and salt marsh (Fig. 29).

119. Less than 20 m. of salt marsh separated the dredged material deposit from several large salt pannes in the upper marsh. The dredged material deposit proper was nearly surrounded by a mixture of *Iva frutescens* and a ground cover of high marsh species including *Spartina patens* and *Juncus gerardi* (Tables 22-23).

120. Moving in towards the center an even mixture of *I. frutescens* and *Phragmites communis* was abundant. This mixture gave way to a band of nearly solid *P. communis*. The center of the island was a shrub thicket dominated by *Myrica pensylvanica* and *Bacchris halimifolia*. *P. communis* was abundant and several 2-4 meter high *Juniperus virginiana* and *Prunus serotina* trees were also present (Table 24).

121. Vegetation on this island was characterized by a mid seral stage. Early and late seral stage vegetation was also present.

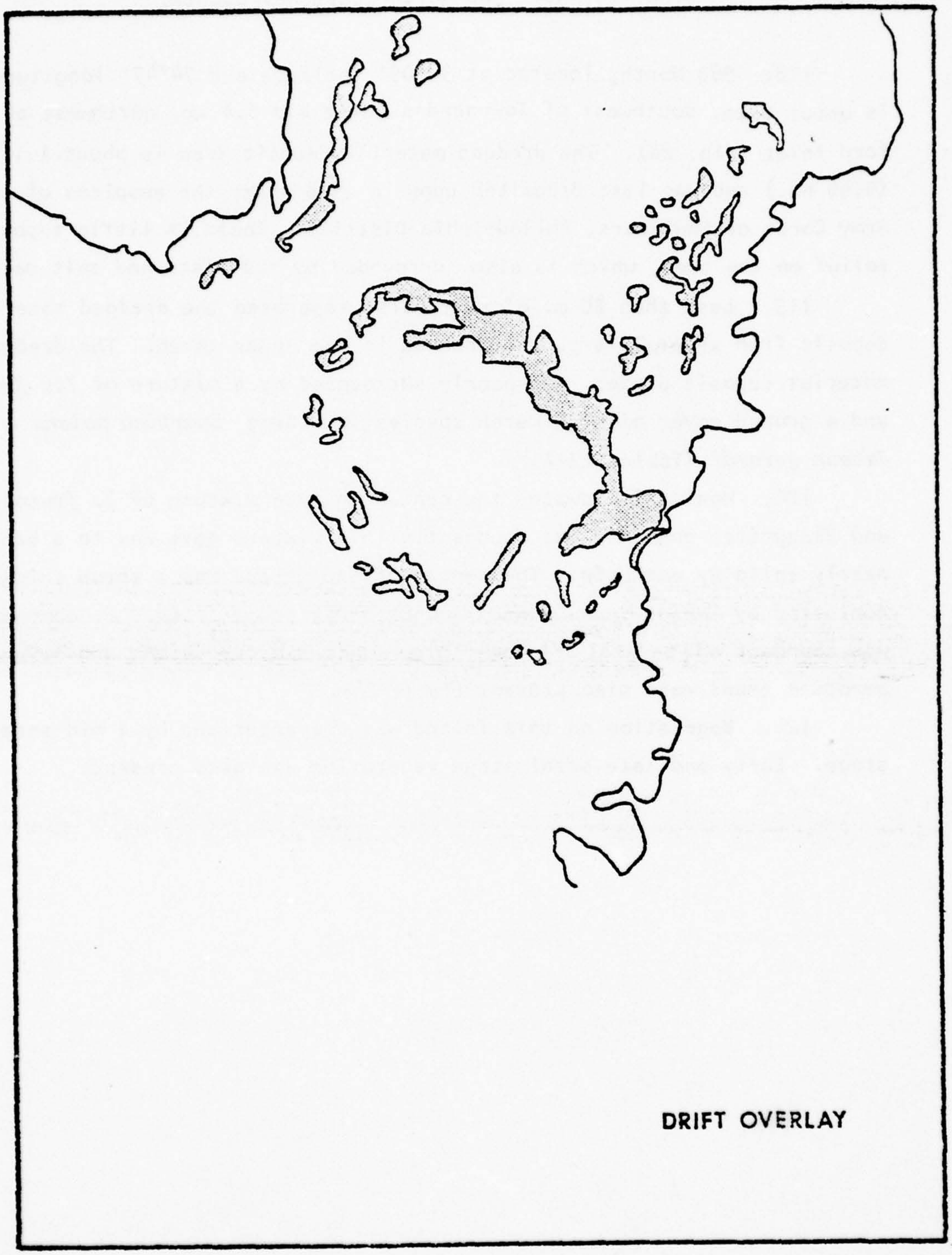

Figure 28. New Jersey dredged
material island #98B North drift overlay.

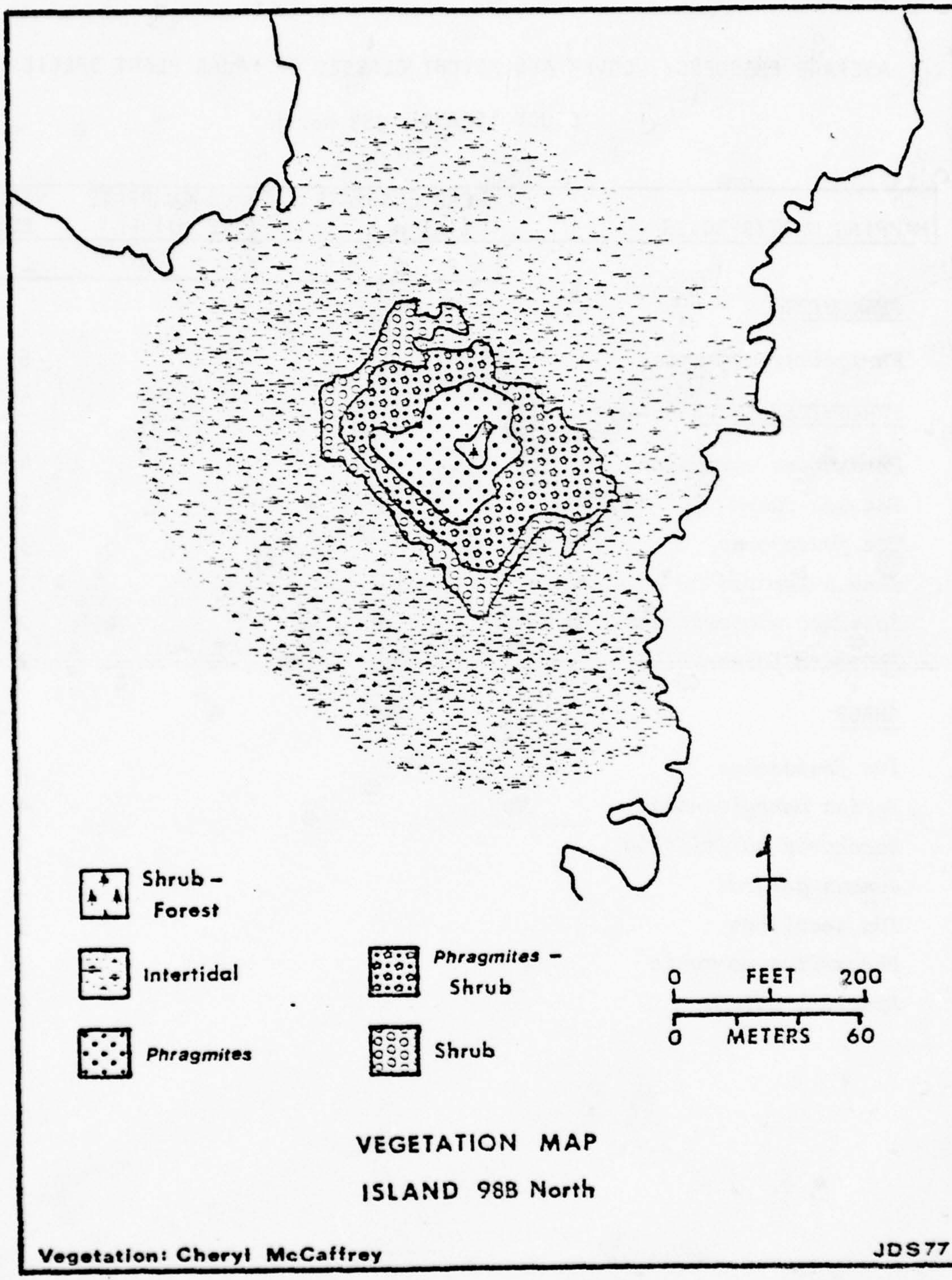

Figure 29. New Jersey dredged
material island #98B North vegetation map.

TABLE 22.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98B North

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>*PHRAGMITES*</u>								
Phragmites communis							5	5
<u>*PHRAGMITES*-SHRUB</u>								
Phragmites communis							4	4
Festuca rubra							3	2
Iva frutescens							3	3
Juncus gerardi							3	2
Solidago sempervirens							2	2
Spartina patens							2	1
<u>SHRUB</u>								
Iva frutescens							5	4
Myrica pensylvanica							4	5
Baccharis halimifolia							3	5
Juncus gerardi							3	2
Iva seedlings							3	1
Phragmites communis							3	5
Spartina patens							2	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 22. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98B North

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>SHRUB-FOREST</u>								
Iva frutescens							5	4
Myrica pensylvanica							4	5
Baccharis halimifolia							3	5
Juncus gerardi							3	2
Iva seedlings							3	1
Phragmites communis							3	5
Spartina patens							2	2
Juniperus virginiana							1	5
Prunus serotina (?)							1	5
<u>INTERTIDAL</u>								
Spartina alterniflora							5	2
Spartina patens							4	2
Distichlis spicata							2	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 23.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 98B North

Deposit Size	1.16 Acres	0.46 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	0.28	0.11	24.0
Phragmites-Shrub	0.58	0.23	49.7
Shrub	0.28	0.11	24.0
Shrub-Forest	0.02	0.01	2.2
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
	1.16	0.46	99.9%
Drift (on deposit)	< 0.01	< 0.01	0.6
Non-drift deposit	1.16	0.46	99.4
	1.16	0.46	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 24.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 98B North

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.51 +	2.63 +
Tidal Flats	-	-
Edge Drift[2]	0.38	0.16
Adjacent Drift[3]	0.09	0.04
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 98B South (Cape May County)

122. 98B South, located at 39°05' latitude and 74°47' longitude, lies less than 500 meters south of 98B North. It too is surrounded by extensive salt marshes, tidal flats and shallow water (Fig. 30). The dredged material deposit is 2.2 acres (.87 ha.) in size, and was last deposited upon in 1968, under the auspices of the U. S. Army Corps of Engineers, Philadelphia District.

123. This island was dominated by *Phragmites communis*, shrubs and *Juniperus virginiana*. The area where marsh meets upland was chiefly vegetated by *Spartina patens* beneath *Iva frutescens* (Fig. 31). A nearly pure stand of *Phragmites* surrounded the outside of the upland vegetation. *Phragmites* and *Iva*, in a *Phragmites* - shrub association, were in equal dominance on the southeast tip of the island.

124. The center of the island contained a shrub thicket dominated by 2-4 m. high *Myrica pensylvanica* and 4-10 m. high *Juniperus virginiana*. Some *P. communis*, *Baccharis halimifolia*, and *Prunus serotina* were present here also. In some areas, the vegetation was quite open, and comprised of a dense grassland, dominated by *Panicum virgatum*, *Andropogon scoparius*, *Festuca rubra* and *Rhus radicadicans*. In some areas the *B. halimifolia*, *P. communis*, *Rhus copalina*, and *J. virginiana* had invaded the dense grassland, though grassland species still composed an herb layer (Tables 25-26).

125. This island had more *Juniperus virginiana* concentrated in one area than did any other island studied, although 78B South also had a large number (Table 27).

126. Vegetation on this island was characterized by a late seral stage, however, early and mid seral stage vegetative communities were also present.

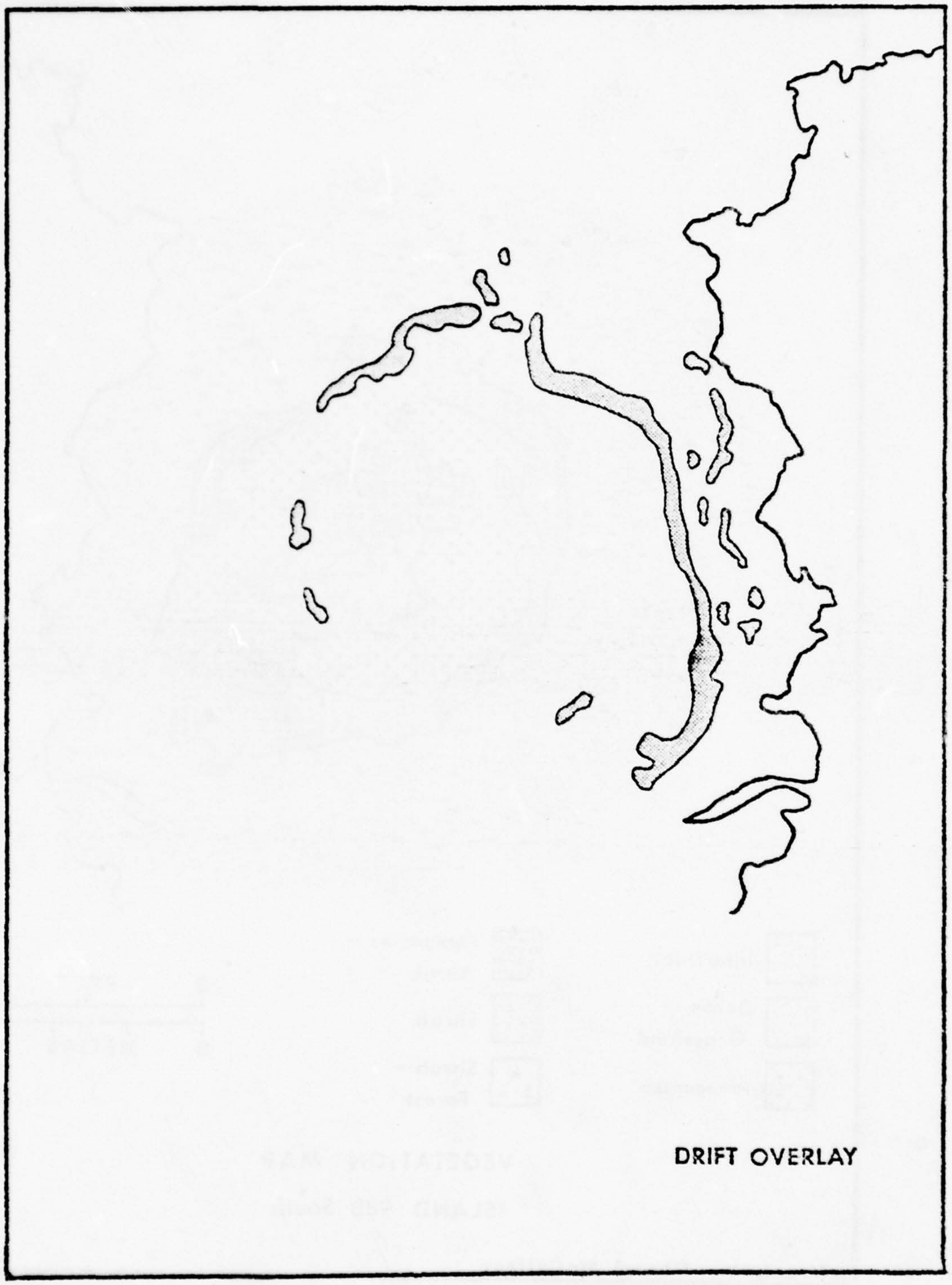

Figure 30. New Jersey dredged
material island #98B South drift overlay.

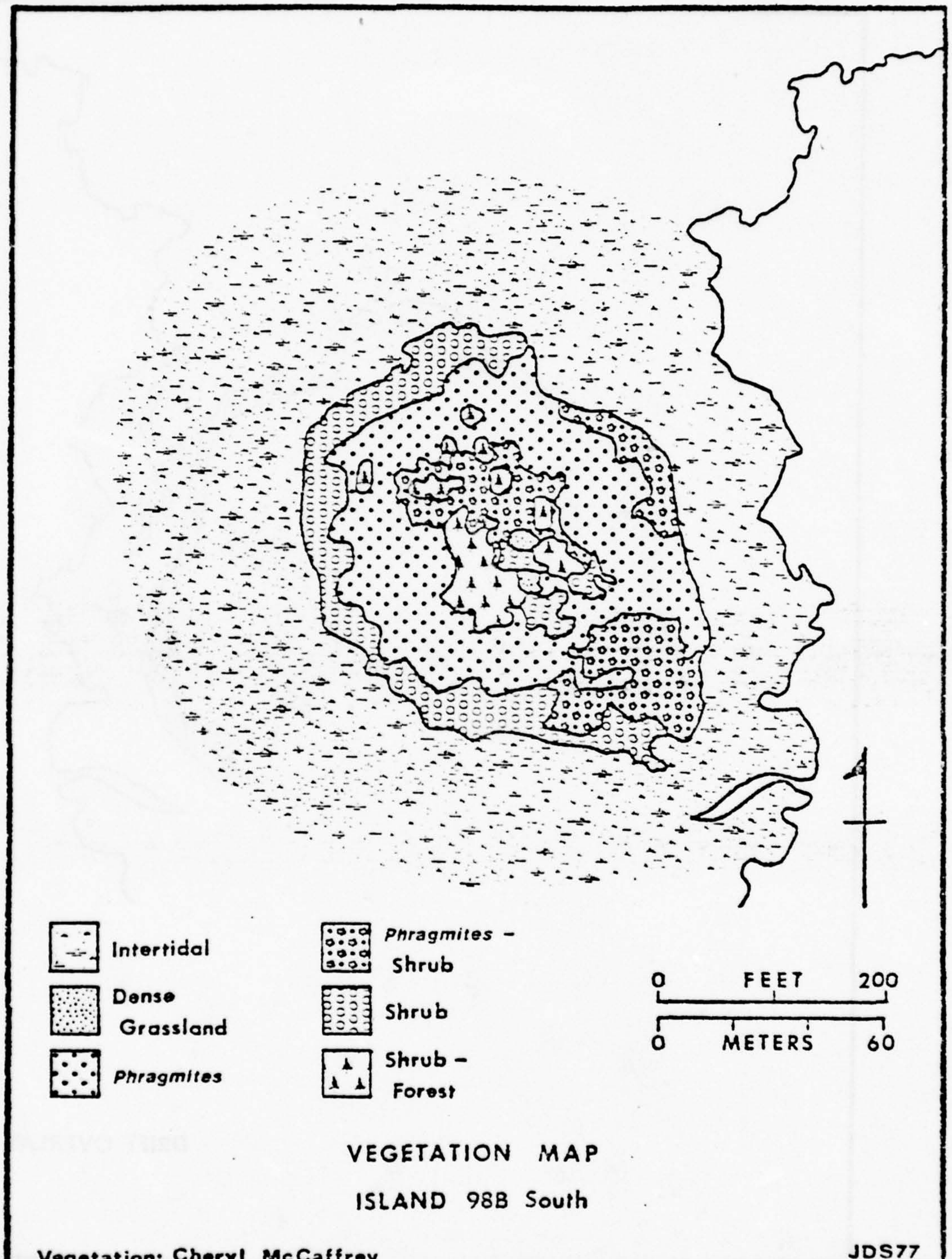

Figure 31. New Jersey dredged material island #98B South vegetation map.

TABLE 25.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98B South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>DENSE GRASSLAND (UPLAND)</u>								
Panicum virginicum							5	2
Andropogon scoparius							4	3
Iva frutescens							4	4
Rhus radicans							3	2
Dead shrubs							2	2
Festuca rubra							2	2
Phragmites communis							2	3
Strophostyles helvola							2	3
<u>*PHRAGMITES*</u>								
Phragmites communis							5	4
Iva frutescens							4	3
Convovulus sepium							2	2
Solidago sempervirens							2	2
<u>SHRUB</u>								
Spartina patens							5	2
Myrica pensylvanica							3	5
Dead shrubs							2	2
Phragmites communis							2	5
Baccharis halimifolia							1	5

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 25. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 98B South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB-FOREST								
Spartina patens							5	2
Juniperus virginiana							3	6
Myrica pensylvanica							3	5
Dead shrubs							2	2
Phragmites communis							2	5
Baccharis halimifolia							1	5
INTERTIDAL								
Spartina alterniflora							5	2
Salicornia europaea							2	2
Spartina patens							2	2
Distichlis spicata							1	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 26.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 983 South

Deposit Size	2.18 Acres	0.87 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.01	< 0.01	0.6
Phragmites	1.05	0.42	48.3
Phragmites-Shrub	0.46	0.18	20.9
Shrub	0.48	0.19	22.1
Shrub-Forest	0.18	0.07	8.1
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
	2.18	0.87	100.0%
Drift (on deposit)	0.04	0.02	2.0
Non-drift deposit	2.14	0.85	98.0
	2.18	0.87	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 27.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 98B South

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.62 +	2.68 +
Tidal Flats	3.33 +	1.35 +
Edge Drift[2]	0.14	0.06
Adjacent Drift[3]	0.02	< 0.01
Adjacent Units[4]	-	-

1. Plant communities occurring outside the deposit boundary on the island;

2. Drift located at the interface of the deposit and the intertidal;

3. Drift scattered in the intertidal area well beyond the deposit boundary;

4. Mapping Units separated from the deposit within the intertidal area.

STUDY ISLAND: 103 (Cape May County)

127. 103, located at 39°02' latitude and 74°48' longitude, is immediately northwest of Hereford Inlet. The northwest end of the island consists of a diked dredged material deposit, which was regarded as a separate study island for purposes of this study (Fig. 32). A road, leading from the developed barrier beach communities, crosses to this island and lies within 230 meters of the study area. The island and deposit area are surrounded by salt marsh and shallow bay areas. The dredged material deposit area was 3 acres (1.2 ha.) in size and last used as a deposition site in 1975, under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

128. Several areas of salt pannes bordered the dike, especially on the south side, farthest from open water. The dike was in a state of disrepair on this side and in some places only a remnant of it remained. *Phragmites communis* was dominant on the dike. Dike vegetation, however, was not limited to *Phragmites* since *Solidago sempervirens*, *Distichlis spicata*, and *Atriplex patula* var. *hastata* were also present. Plants common to the high marsh, or drift areas, *Spergularia marina*, *Sesuvium maritima*, *Spartina alterniflora* and *Cakile edentula* were also found on the dike area (Tables 28-29).

129. Inside the dike, the area was mostly bare sand or caked dredged sediments, with large shells throughout. Some debris was also in evidence. Species vegetating the dike were also found occasionally on the bare area. The center of the deposit was vegetated by 1-2 meter high *P. communis* with some *Atriplex* growing on the caked mud. *Phragmites* was advancing from the center on to the bare area (Table 30).

130. Vegetation on the dredged material deposit area studied on this island was characteristic of an early seral stage (Fig. 33).

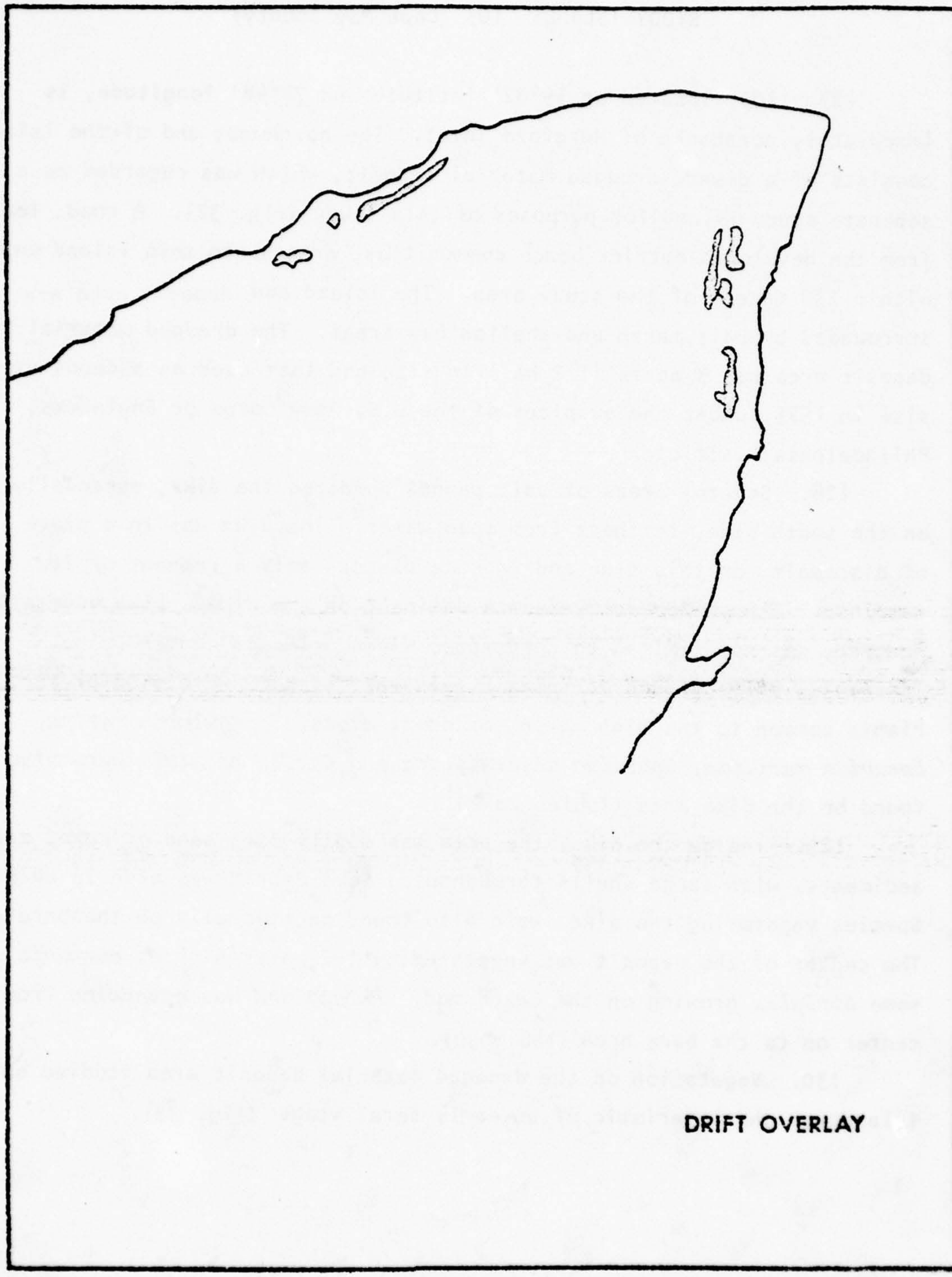

Figure 32. New Jersey dredged material island #103 drift overlay.

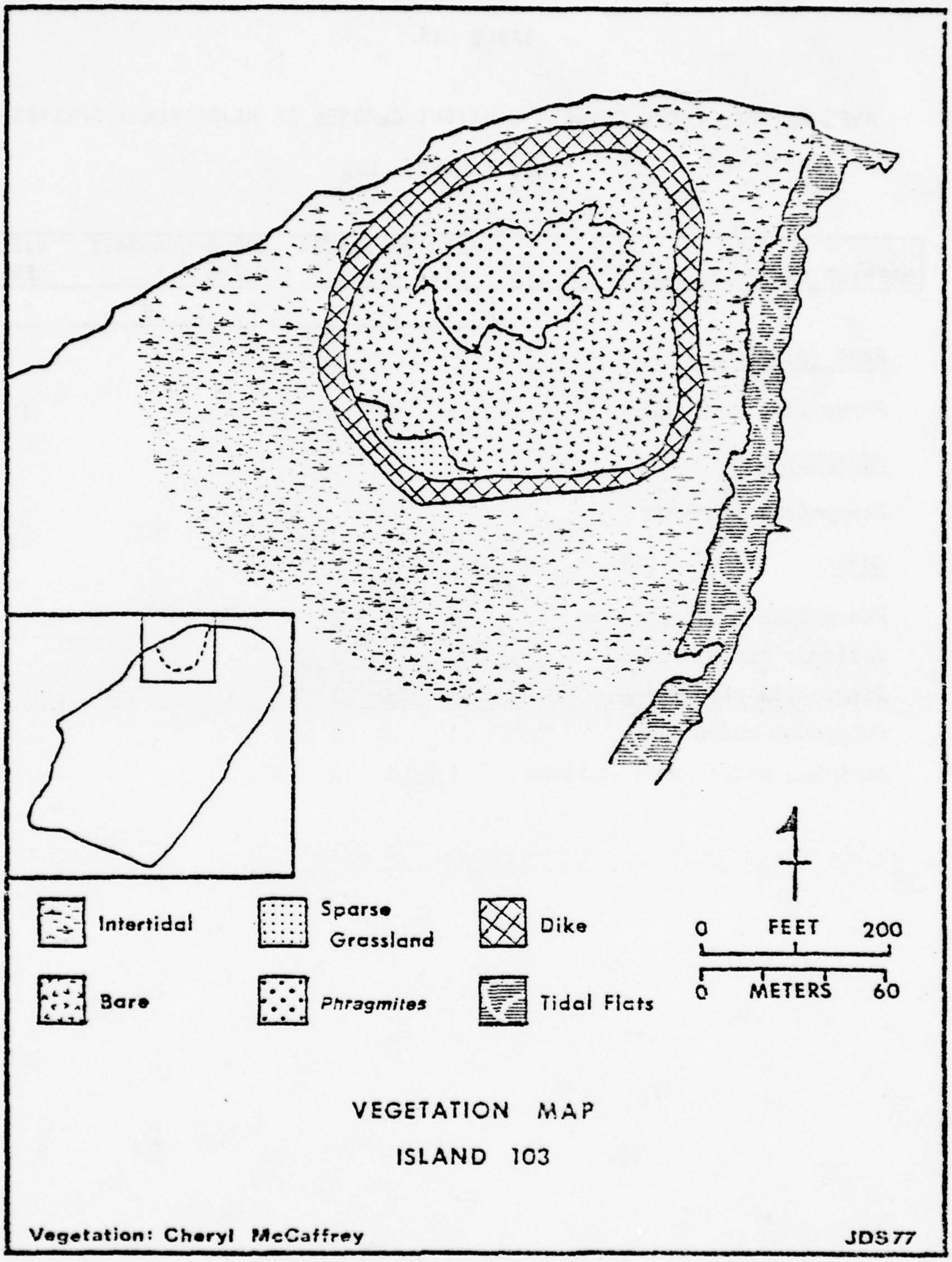

Figure 33. New Jersey dredged material island #103 vegetation map.

TABLE 28.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 103

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
BARE (DIKE)								
Phragmites communis	2	2	3				1	3
PHRAGMITES								
Phragmites communis							5	5
DIKE								
Phragmites communis	4	2	3					
Solidago sempervirens	2	2	2					
Distichlis spicata	1	2	2					
Polygonum aviculare	1	2	2					
Atriplex patula var. *hastata*	1	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 29.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 103

Deposit Size	2.92 Acres	1.19 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	1.78	0.72	61.0
Sparse Grassland	0.08	0.03	2.6
Dense Grassland	-	-	-
Phragmites	0.43	0.17	14.6
Phragmites-Shrub	-	-	-
Shrub	-	-	-
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	0.63	0.26	21.7
	2.92	1.18	99.9%
Drift (on deposit)	-	-	-
Non-drift deposit	2.92	1.18	100.0
	2.92	1.18	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 30.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 103

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	4.56 +	1.85 +
Tidal Flats	0.77 +	0.31 +
Edge Drift[2]	0.07	0.03
Adjacent Drift[3]	-	-
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 109 (Cape May County)

131. 109, located at 38°53' latitude and 74°51' longitude, lies about 5.6 km. southwest of Hereford Inlet, and is separated by a channel from Wildwood Crest, New Jersey. Less than 3.2 km. of salt marsh separates it from the mainland (Fig. 34). A sewage treatment facility exists on the southeast side of the island. Despite its proximity to development, there seemed to be little human use of the southwestern side of the island. Dredged material was last deposited on Shaw Island in 1965 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

132. Shaw Island is a large island, 81 acres (32.8 ha.) in size, and contains several dredged material deposits. Aerial photographs showed the circular growth patterns reflecting dredged material deposition patterns clearly. Only one 5.3 acre (2.1 ha.) area was studied, an area exhibiting circular vegetative growth patterns on the southwest and which also harboured a heronry (Fig. 35). (However, vegetation on the next northern deposit was actually sampled because it was similar to vegetation in the same mapping units within the colony area and could be entered without damage to the nesting birds.)

133. The island was a complex mixture of *Phragmites communis*, *Myrica pensylvanica*, *Baccharis halimifolia*, *Rhus copallina*, *Juniperus virginiana*, *Iva frutescens*, and high marsh and successional drift species (Tables 31-32). The salt marsh border of the southwestern deposit area was salt panne in some places and abundant drift material in others. On the west side of the deposit were areas of high marsh dominated by *Spartina patens* with abundant *I. frutescens*. On the northeast side was a stand of *P. communis*. The east side had a shrub thicket with *M. pensylvanica*, *B. halimifolia*, *R. copallina*, *R. radicans*, and *Parthenocissus quinquefolia*. Occasional *J. virginiana* and *Prunus serotina* also occurred in the shrub thickets. Large areas included mixtures of 3 meter high *Phragmites* and shrubs of equal height.

134. Vegetation on this island was characterized by a mid seral stage. Early and late seral stage vegetation was also present (Table 33).

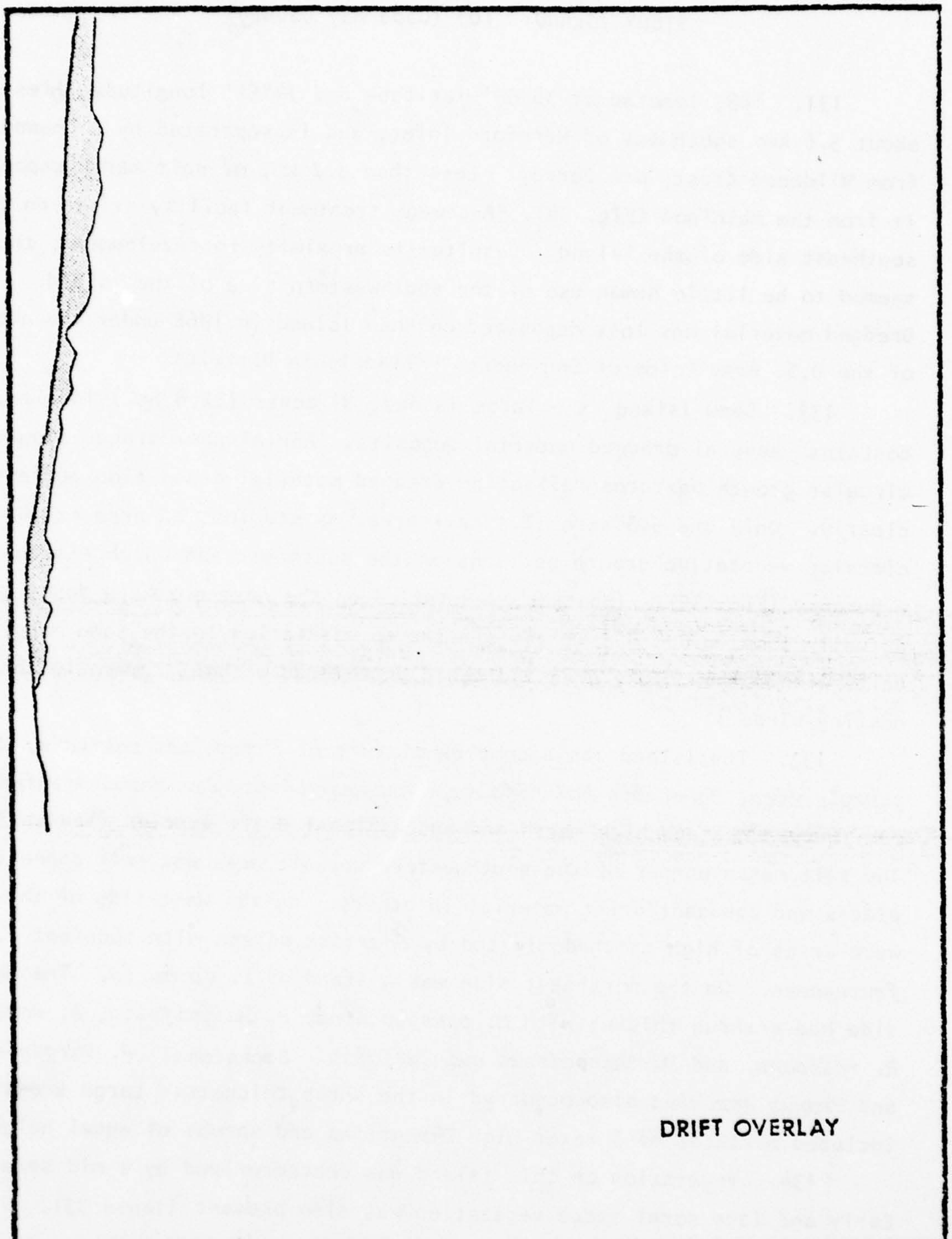

Figure 34. New Jersey dredged material island #109 drift overlay.

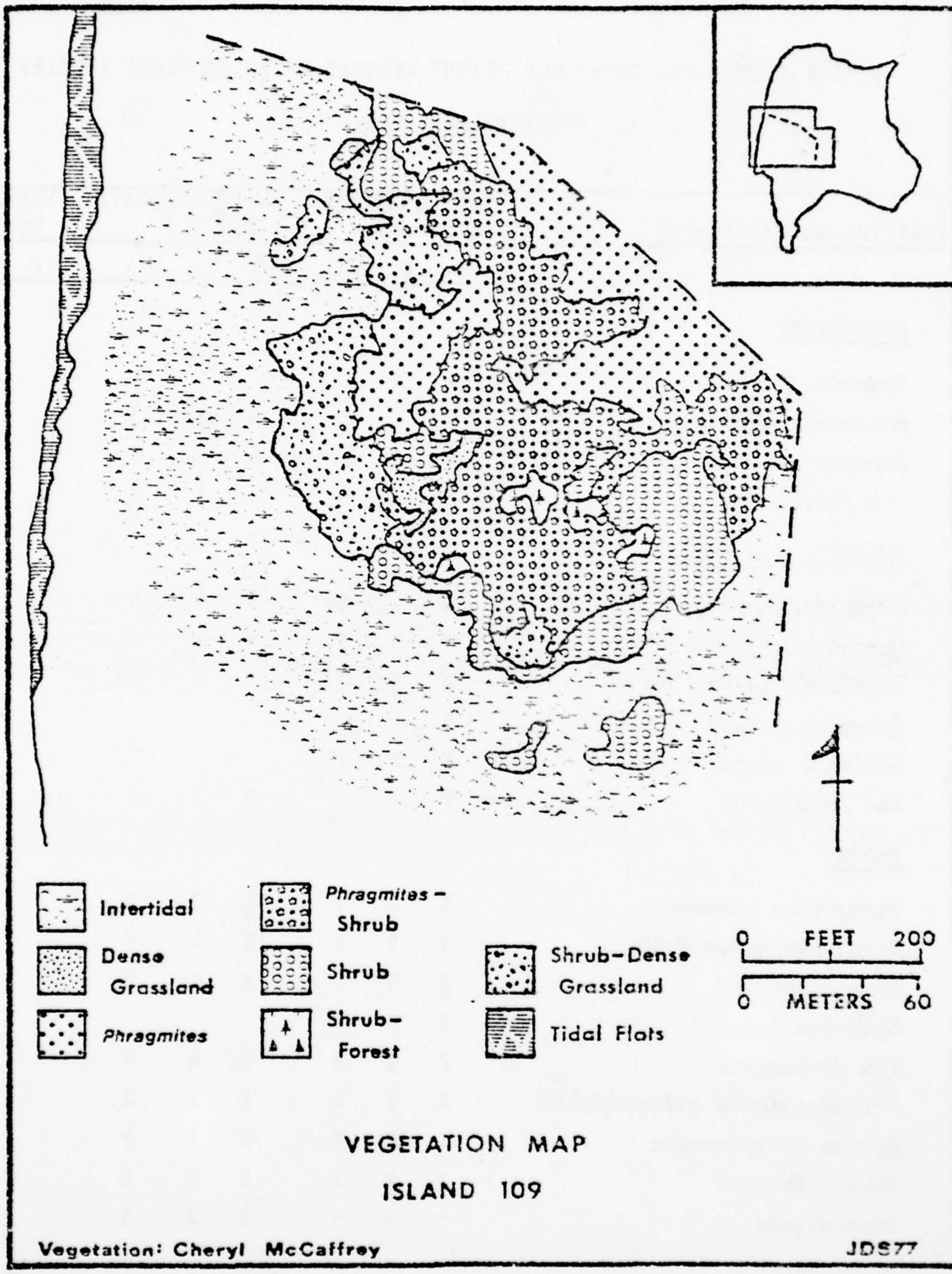

Figure 35. New Jersey dredged material island #109 vegetation map.

TABLE 31.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 109

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>*PHRAGMITES*</u>								
Spartina patens	4	3	4					
Baccharis halimifolia	4	2	2	4	2	2		
Phragmites communis	4	2	3	4	2	3		
Iva frutescens	-	-	-	4	1	3		
<u>*PHRAGMITES* - SHRUB</u>								
Phragmites communis	4	4	5	4	4	3		
Myrica pensylvanica	3	3	5	4	3	5		
Baccharis halimifolia	2	3	4	3	3	5		
Spartina patens	2	3	2					
Solidago sempervirens	2	2	3					
Iva frutescens	1	2	4	2	1	4		
<u>SHRUB</u>								
Phragmites communis	3	2	4	3	2	5		
Baccharis halimifolia	3	3	5	3	4	5		
Rhus copallina	3	4	4	3	4	4		
Spartina patens	3	3	2					
Iva frutescens	2	3	3	2	4	4		
Parthenocissus quinquefolia	2	2	2	2	1	2		
Myrica pensylvanica	1	2	3	2	1	4		
Rhus radicans	2	2	2	2	3	2		
Dead shrubs	-	-	-	2	2	5		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 31. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 109

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB-DENSE GRASSLAND								
Spartina patens	4	3	2					
Baccharis halimifolia	2	2	3	2	2	2		
Solidago sempervirens	2	2	2					
Distichlis spicata	2	3	2					
Iva frutescens	2	2	3	3	3	3		
Phragmites communis	1	2	4	1	2	4		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 32.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 109

Deposit Size	5.28 Acres	2.14 Hectares	6.51% of Island
Island Size	81 Acres	32.8 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	0.09	0.04	1.7
Dense Grassland	-	-	-
Phragmites	1.29	0.52	24.4
Phragmites-Shrub	2.11	0.85	40.1
Shrub	0.80	0.33	15.2
Shrub-Forest	0.09	0.04	1.7
Shrub-Dense Grassland	0.90	0.36	16.9
Dike	-	-	-
	5.28	2.14	100.0%
Drift (on deposit)	-	-	-
Non-drift deposit	5.28	2.14	100.0
	5.28	2.14	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 33

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #109

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	5.01 +	2.06 +
Tidal Flats	5.30 +	2.15 +
Edge Drift[2]	0.42	0.17
Adjacent Drift[3]	0.48	0.19
Adjacent Units[4] (total)	8.19 +	3.32 +
Phragmites	1.91 +	0.77 +
Phragmites-Shrub	2.53 +	1.03 +
Shrub	2.78 +	1.13 +
Shrub-Dense Grassland	0.98 +	0.39 +
Drift (on deposit)	0.11 +	0.04 +
Edge Drift	0.53 +	0.21 +
Adjacent Drift	1.41 +	0.57 +

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: A12 North (Ocean County)

135. A12 North, located at 39°57' latitude and 74°05' longitude, is west of Ortley Beach, New Jersey, and directly north of study island A12. The dredged material deposition is about 1.5 acres (0.6 ha.) in size and the entire island is approximately 15.8 acres (6.4 ha.) in size (Fig. 36). The dredged material deposit is of unknown origin and pre-dates 1969 (F. Lesser, pers. comm.) The island is located within 1.8 km. of marinas and cottages on the barrier beach and receives frequent human recreational use of its sandy beach from boaters and local residents.

136. A band of salt marsh separated the dredged material deposit studied from an older, domed deposit on the west side of the island (Fig. 37). The western deposit had two domes with sparse to dense grassland surrounded by shrub thicket, containing scattered trees and extensive stands of *Phragmites communis*.

137. The studied portion of the island also had a domed configuration. The center was bare, with some pebble and shell. Its estimated elevation was 1.5-2.4 meters. The base of the bare dome was encircled by a sparse grassland of low *Phragites* which graded into taller *Phragmites*, approximately 1.5 meters high. Portions of the *Phragmites* covered area, were mixed with scattered 1-1.5 meter high *Myrica pensylvanica* and *Baccharis halimifolia* or were interrupted by shrub thickets of the same woody composition. At the upper border of the salt marsh, the *Phragmites* mingled with *Spartina patens* (Tables 34-35).

138. This deposit exhibited the earliest seral stage of any non-diked, non-bird colony study island, though 51B and A12 were also domed and sparsely vegetated. Mid and late seral stages were, however, present on the island, although the studied area was characterized by an early seral stage (Table 36).

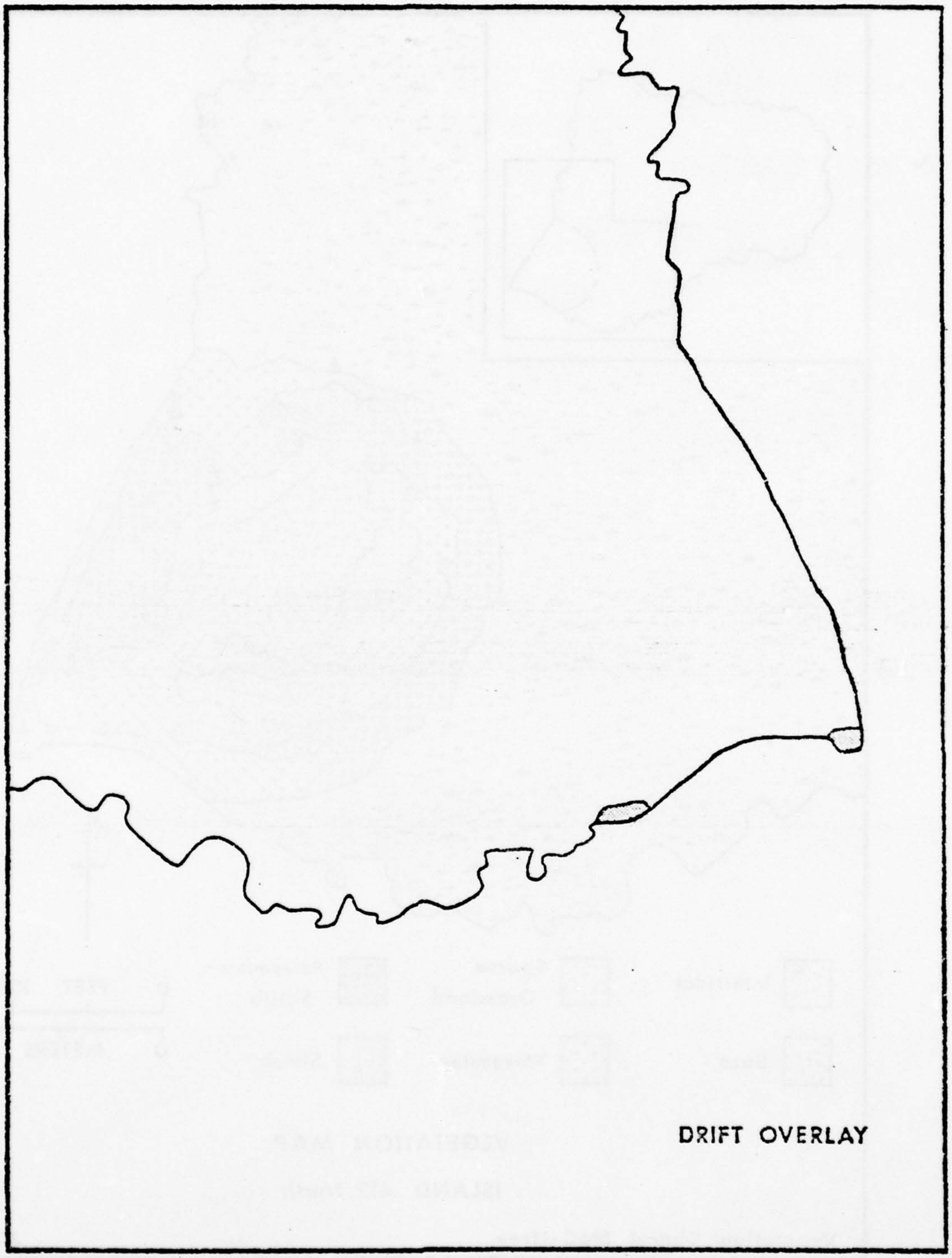

Figure 36. New Jersey dredged material island #A12 North drift overlay.

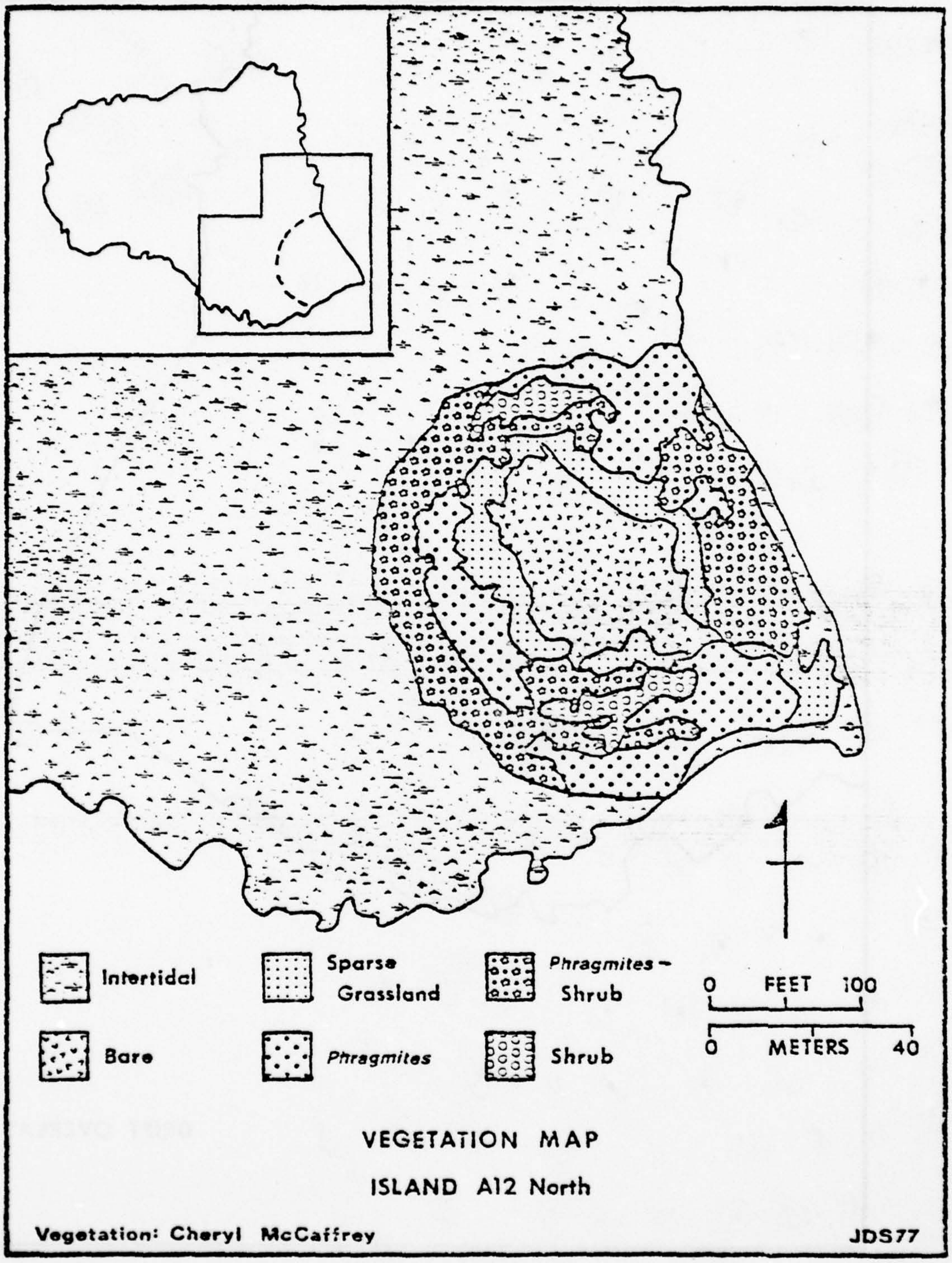

Figure 37. New Jersey dredged material island #A12 North vegetation map.

TABLE 34.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A12 North

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
BARE (UPLAND)								
Bromus tectorum	2	1	2					
Triplasis purpurea	2	1	1					
Phragmites communis	1	1	3					
SPARSE GRASSLAND								
Eragrostis spectabilis (?)	2	2	2					
Phragmites communis	4	2	3	4	2	3		
PHRAGMITES								
Myrica pensylvanica	4	2	3	4	4	3		
Phragmites communis	4	1	2	4	2	4		
Erigeron pusillus	4	1	2					
Spartina patens	4	1	2					
PHRAGMITES-SHRUB								
Phragmites communis	4	2	4	4	1	4		
Baccharis halimifolia	2	5	4	4	2	4		
Spartina patens	4	5	2					
Myrica pensylvanica	2	4	4					
INTERTIDAL								
Spartina patens	4	5	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 35.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #A12 North

Deposit Size	1.50 Acres	0.61 Hectares	9.50% of Island
Island Size	15.79 Acres	6.39 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	0.28	0.11	18.8
Sparse Grassland	0.21	0.09	14.0
Dense Grassland	-	-	-
Phragmites	0.44	0.18	29.1
Phragmites-Shrub	0.51	0.21	34.3
Shrub	0.06	0.02	3.8
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
	1.50	0.61	100.0%
Drift (on deposit)	-	-	-
Non-drift deposit	1.50	0.61	100.0
	1.50	0.61	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 36.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #A12 North

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.48	2.62
Tidal Flats	-	-
Edge Drift[2]	-	-
Adjacent Drift[3]	0.04	0.02
Adjacent Units[4] (total)	7.82	3.16
Sparse Grassland	0.07	0.03
Dense Grassland	0.04	0.01
Phragmites	4.82	1.95
Phragmites-Shrub	1.54	0.62
Shrub	1.27	0.51
Shrub-forest	0.08	0.03

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

AD-A061 843 MANOMET BIRD OBSERVATORY MA F/G 13/3
USE OF DREDGED MATERIAL ISLANDS BY COLONIAL SEABIRDS AND WADING--ETC(U)
JUN 78 F G BUCKLEY, C A MCCAFFREY DACW39-76-C-0166

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STUDY ISLAND: A43a (Ocean County)

139. A43a, located at 39°36' latitude and 74°13' longitude, is 11.3 km. north of Beach Haven Inlet. The southeastern tip of the island had a dredged material deposit of 2.8 acres (1.1 ha.) of unknown age and origin. The entire island is almost 20 acres (7.8 ha.) in size.

140. Most of the island was salt marsh with drift mats concentrated near the daily high tide mark (Fig. 38). The dredged material area had only slight elevation though it was covered with tall vegetation.

141. A dense growth of *Phragmites communis* dominated the area. (Tables 37-38). Portions of the area had an abundance of 1-1.5 meter high *Myrica pensylvanica* and *Baccharis halimifolia* mixed with 2 meter tall *Phragmites*. High marsh vegetation extended into the interior of the *Phragmites* associations as indicated on the accompanying vegetation map (Fig. 39).

142. This island was in an early seral stage, though vegetation indicative of mid seral stages was present as well (Table 39).

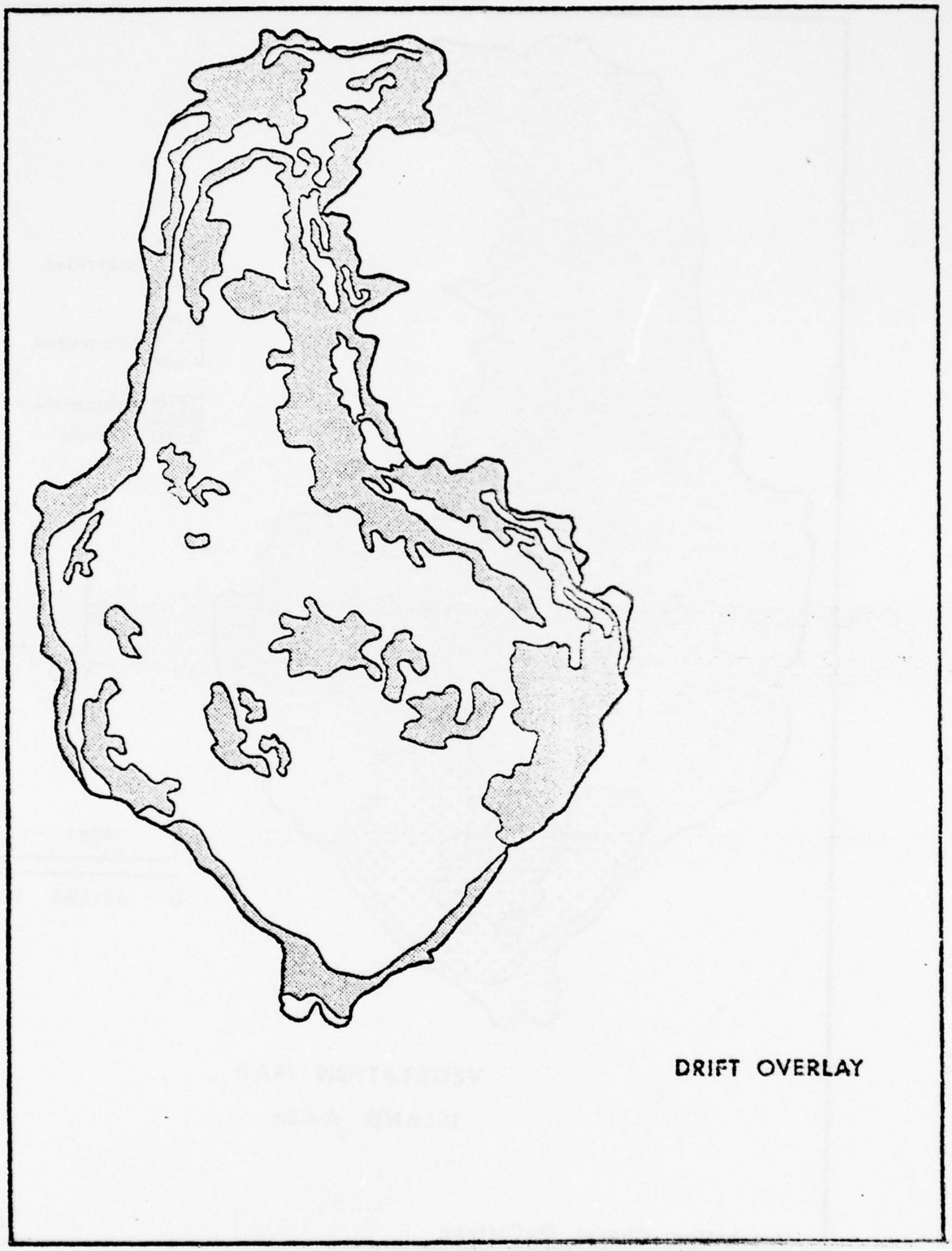

Figure 38. New Jersey dredged material island #A43a drift overlay.

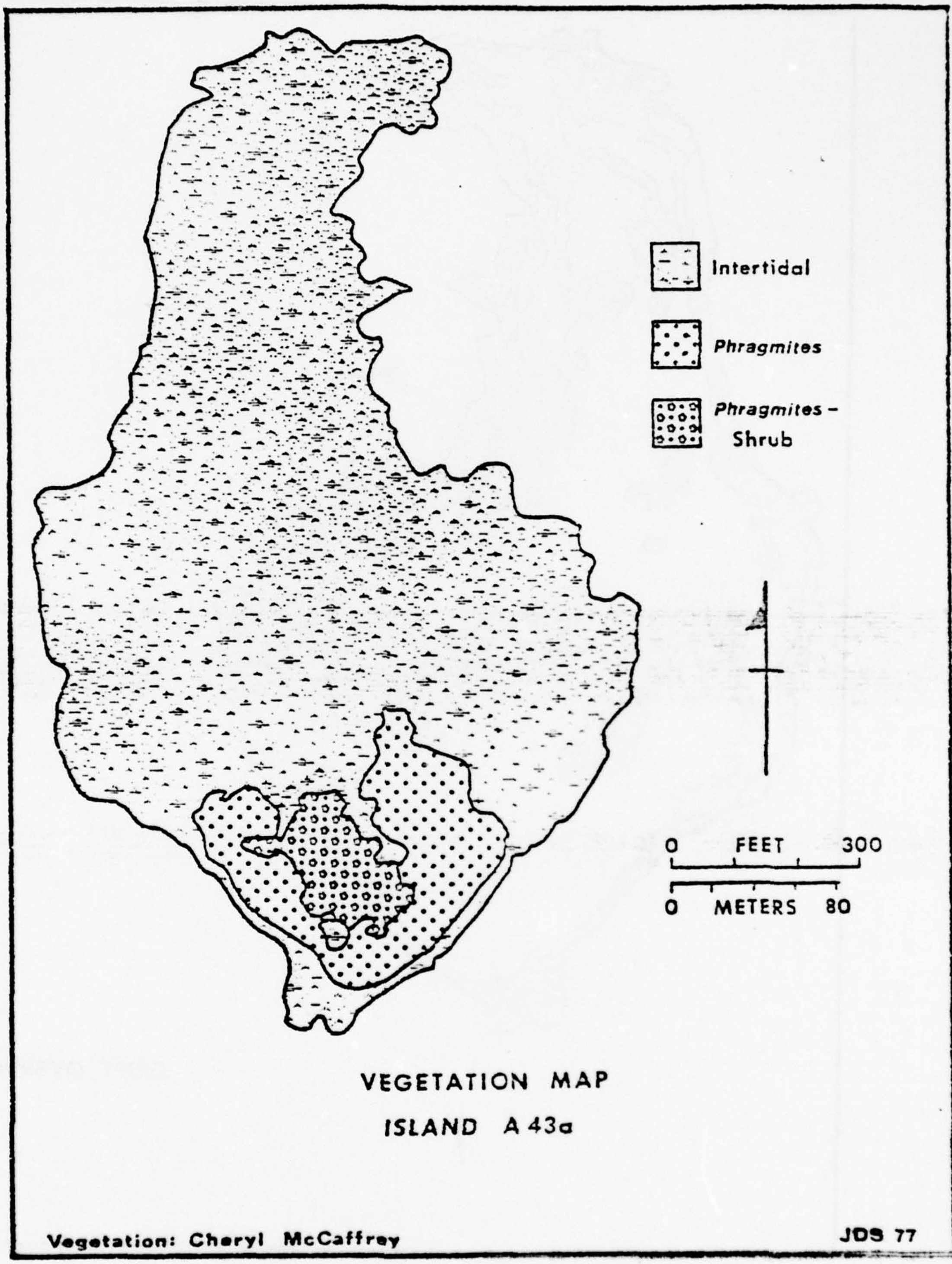

Figure 39. New Jersey dredged material island #A43a vegetation map.

TABLE 37.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A43a

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES								
Phragmites communis	4	5	5	4	5	5		
PHRAGMITES-SHRUB								
Phragmites communis	4	2	4	4	3	4		
Spartina patens	3	3	2					
Solidago sempervirens	3	1	2					
Baccharis halimifolia	-	-	-	3	2	3		
Myrica pensylvanica	2	2	4	2	3	4		
Dead shrubs	1	2	4	2	2	4		
INTERTIDAL								
Spartina patens	3	4	2					
Spartina alterniflora	3	3	2					
Atriplex patula var. *hastata*	1	1	2					
Salicornia europaea	1	1	2					
Distichlis spicata	1	2	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 38.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #A43a

Deposit Size	2.79 Acres	1.12 Hectares	14.49% of Island
Island Size	19.18 Acres	7.76 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	1.87	0.75	67.0
Phragmites-Shrub	0.69	0.28	24.7
Shrub	-	-	-
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
Intertidal (within deposit)	0.23	0.09	8.2
	2.79	1.12	99.9%
Drift (on deposit)	-	-	-
Non-drift deposit	2.79	1.12	100.0
	2.79	1.12	100.0%

1. *percentages are based upon dot counts determined by use of a dot grid.*

TABLE 39

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # A43a

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	16.40	6.64
Tidal Flats	-	-
Edge Drift[2]	0.49	0.20
Adjacent Drift[3]	6.99	2.83
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 45B (Ocean County)

143. 45B, located at 39°34' latitude and 74°15' longitude, is directly west of study island 45A, and 8 km. north of Beach Haven Inlet (Fig. 40). A house was situated on the middle of the island. The island was last used for dredged material deposition in 1963, under the auspices of the U.S. Army Corps of Engineers, Philadelphia District. The island had little topographic relief and was 4 acres (1.6 ha.) in size, with about 2.6 acres (1 ha.) of it covered by dredged material.

144. A small salt marsh bordered the dredged material deposition, its upper edge bordered by *Iva frutescens* (Fig. 41). The *Iva* met a dense stand of *Phragmites communis*, which was more open at the center of the island than it was near the marsh. *Myrica pensylvanica* and *Baccharis halimifolia* were occasionally scattered through the *Phragmites* (Tables 40-41). A lawn surrounded the house.

145. Because of the island's private ownership, and its similarity to other islands studied, minimal field work was done on this island.

146. The island was characterized by an early seral stage but mid and late seral stage vegetation was also present (Table 42).

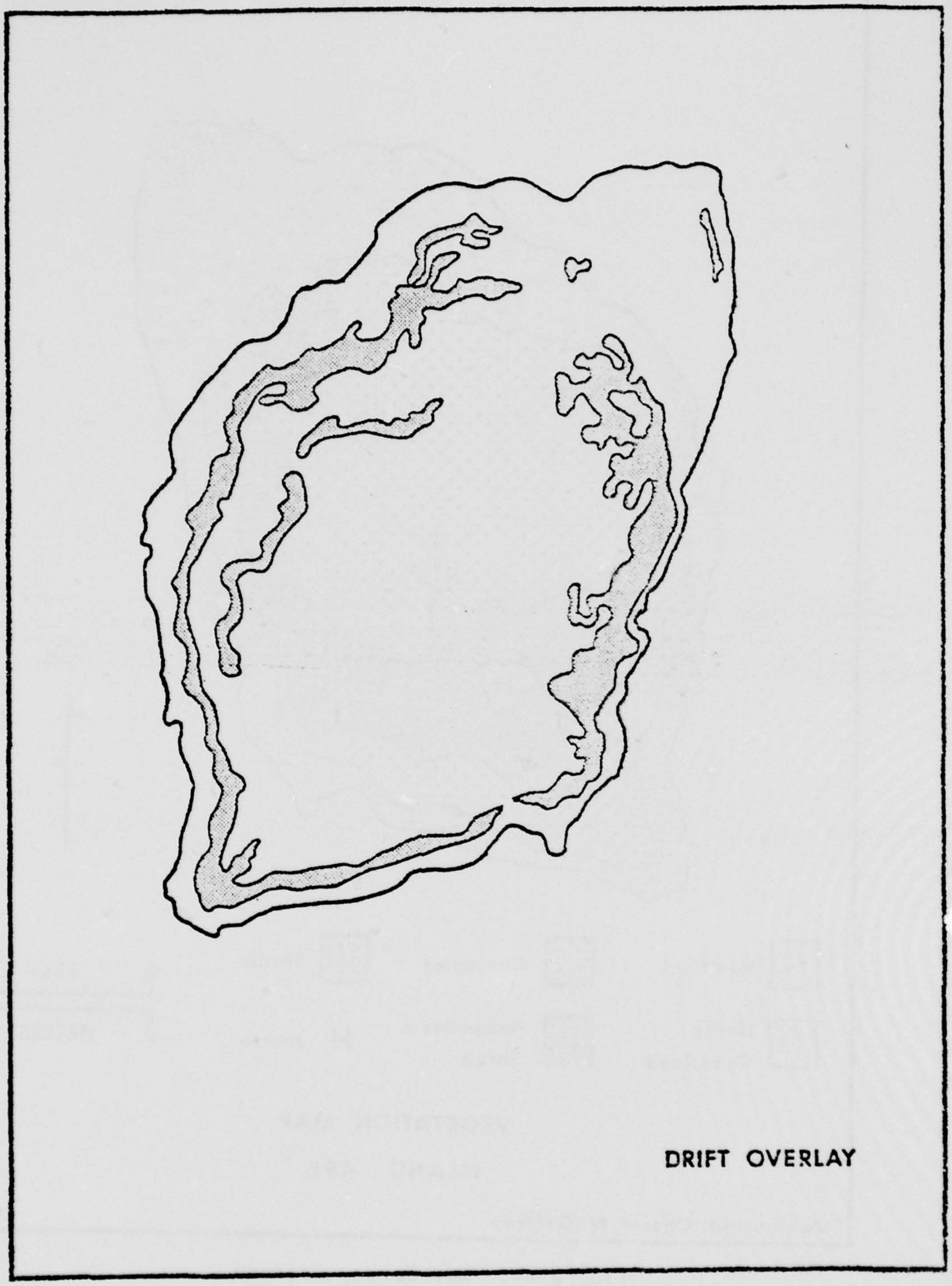

Figure 40. New Jersey dredged material island #45B drift overlay.

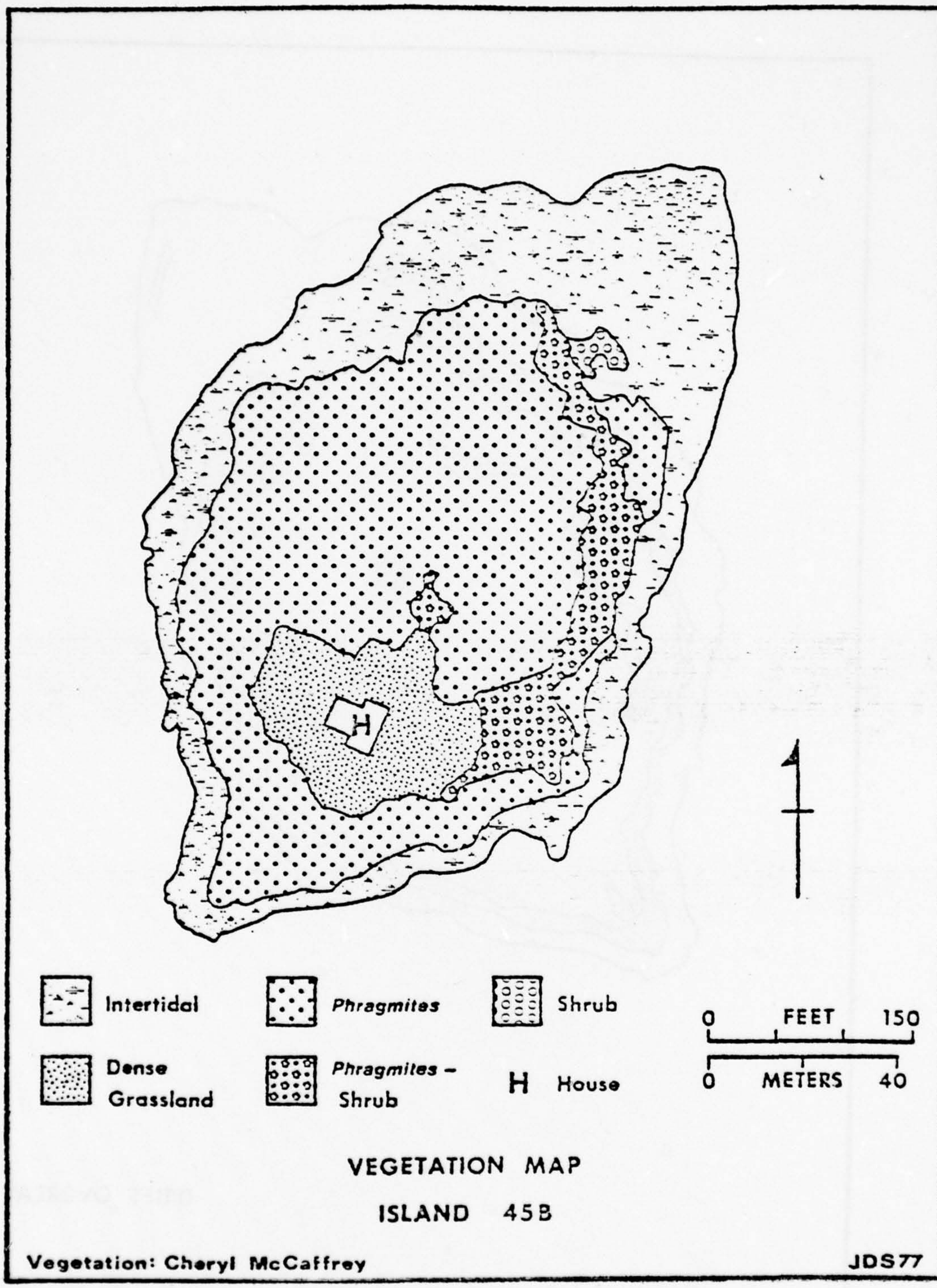

Figure 41. New Jersey dredged material island #45B vegetation map.

TABLE 40.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 45B

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES								
Phragmites communis							4	4
Baccharis halimifolia							2	4
PHRAGMITES-SHRUB								
Phragmites communis							4	4
Baccharis halimifolia							3	4
Iva frutescens							4	3
INTERTIDAL								
Limonium nashii							1	2
Spartina alterniflora							5	2
Spartina patens							3	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 41.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 45B

Deposit Size	2.61 Acres	1.05 Hectares	64.44% of Island
Island Size	4.05 Acres	1.64 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.35	0.14	13.3
Phragmites	1.92	0.78	73.8
Phragmites-Shrub	0.29	0.12	11.2
Shrub	0.03	0.01	1.0
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
House	0.02	<0.01	0.7
	2.61	1.05	100.0%
Drift (on deposit)	0.15	0.06	5.58
Non-drift deposit	2.46	0.99	94.42
	2.61	1.05	100.00%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 42.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 45B

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	1.46	0.59
Tidal Flats	-	-
Edge Drift[2]	0.23	0.09
Adjacent Drift[3]	<0.01	<0.01
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

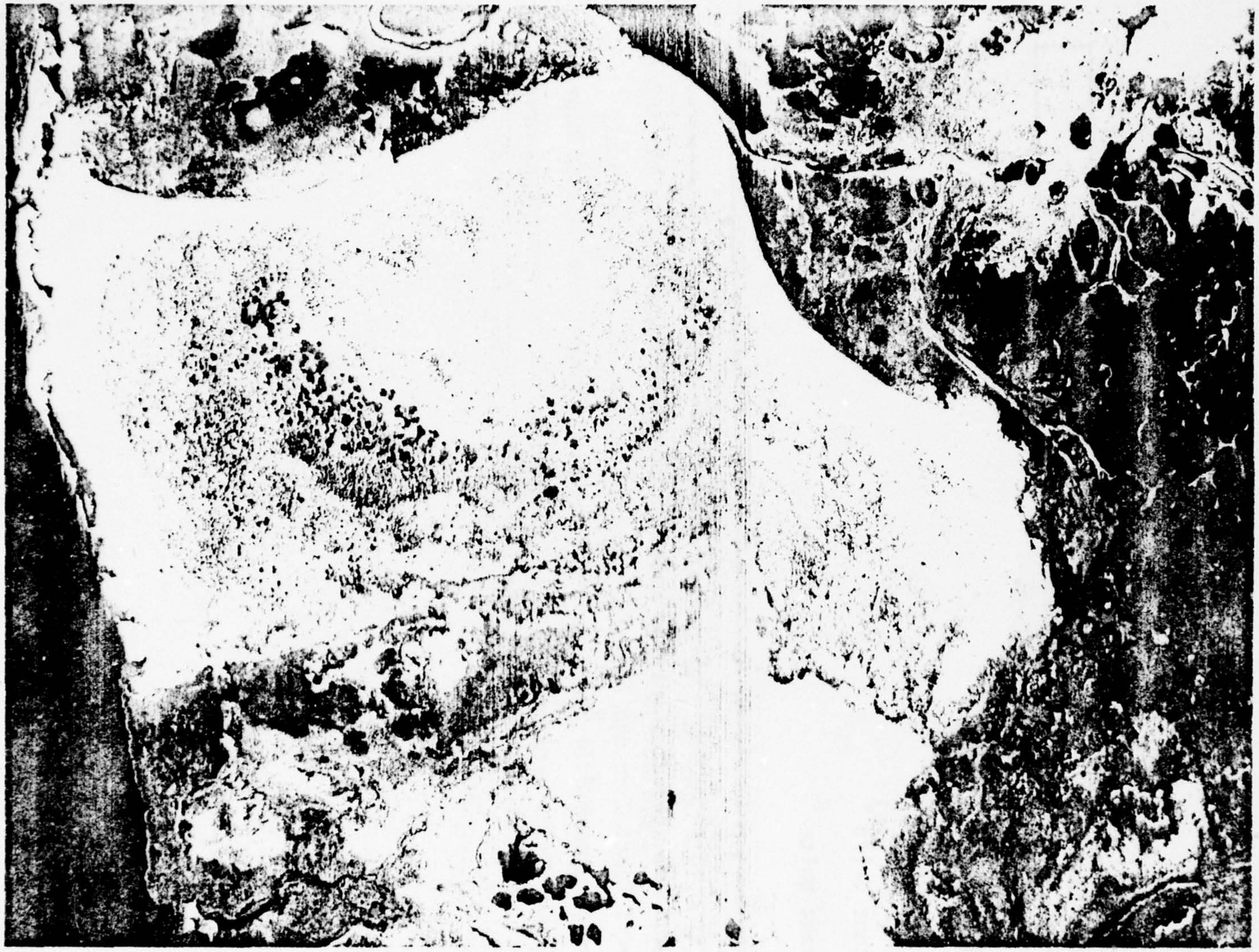

Figure 42. Aerial photo of Study Island 51B.

STUDY ISLAND: 51B (Ocean County)

147. 51B, located at 39°31 latitude and 74°18' longitude, and directly opposite Beach Haven Inlet, consists of a 4.5 acre (1.8 ha.) dredged material deposition. The dredged material was deposited upon a large area of salt marsh, which extends about 7.2 km. from Tuckerton, New Jersey, on the mainland, in 1965 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

148. The dredged material deposition was basically rectangular in shape, with a cut off pattern to the arching vegetative zone, suggestive of erosion of the deposit (Fig. 42). Sides of the surrounding salt marsh were badly eroded and seemed subject to erosion by wave attack. Much of the marsh surface was non-vegetated peat and salt panne (Fig. 43). Drift material was found part way up the deposit dome, probably left by storm tides.

149. The dome rises to at least one meter in elevation, with sand and shell beneath the sparse vegetation (Fig. 44). *Solidago sempervirens*, *Eragostis spectabillis (?)*, and *Erigeron pusillus* are the most abundant plants. The base of the dome was dominantly an *Ammophila brevilulata* grassland. On the south, this gradually descended to a mixture of *Phragmites communis*, 1-1.5 meters tall, growing above an *A. breviligulata* herb layer. *Myrica pensylvanica* shrubs were scattered throughout, and a large area of drift was beneath some of the sparser *Phragmites* areas. The northern side had a similar mixture of *Phragmites* and low grasses and herbs but with abundant *M. pensylvanica* and *Baccharis halimifolia* scattered throughout. The western side had a high marsh with a mixture of *P. communis* on the upper edge. The marsh was frequently bordered by *Iva frutescens*, *P. communis* and *B. halimifolia* (Tables 43-44).

150. On 51B, the characteristic seral stage was an early one, though vegetation indicative of mid seral stages was also present (Table 45).

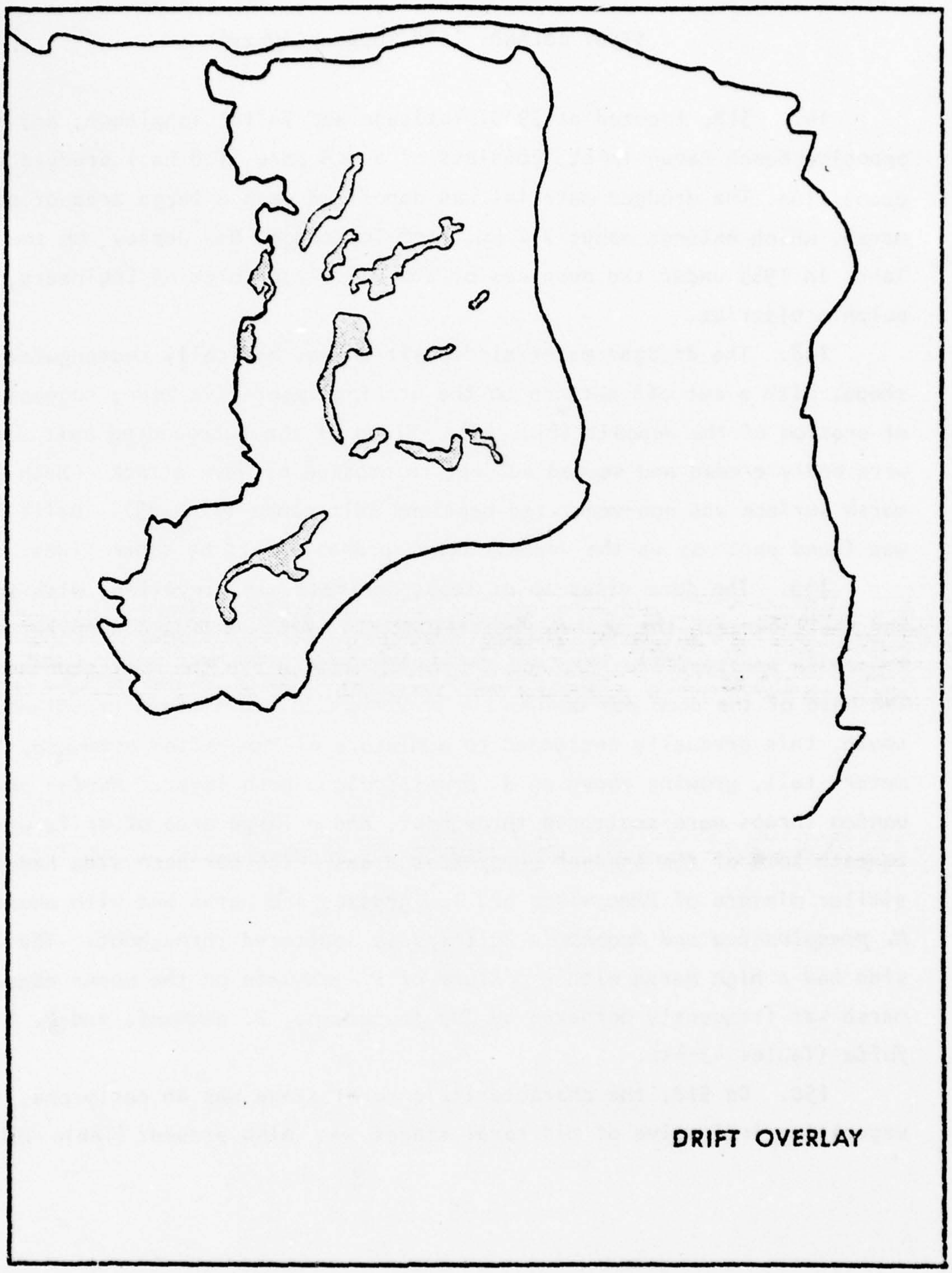

Figure 43. New Jersey dredged material island #51B drift overlay.

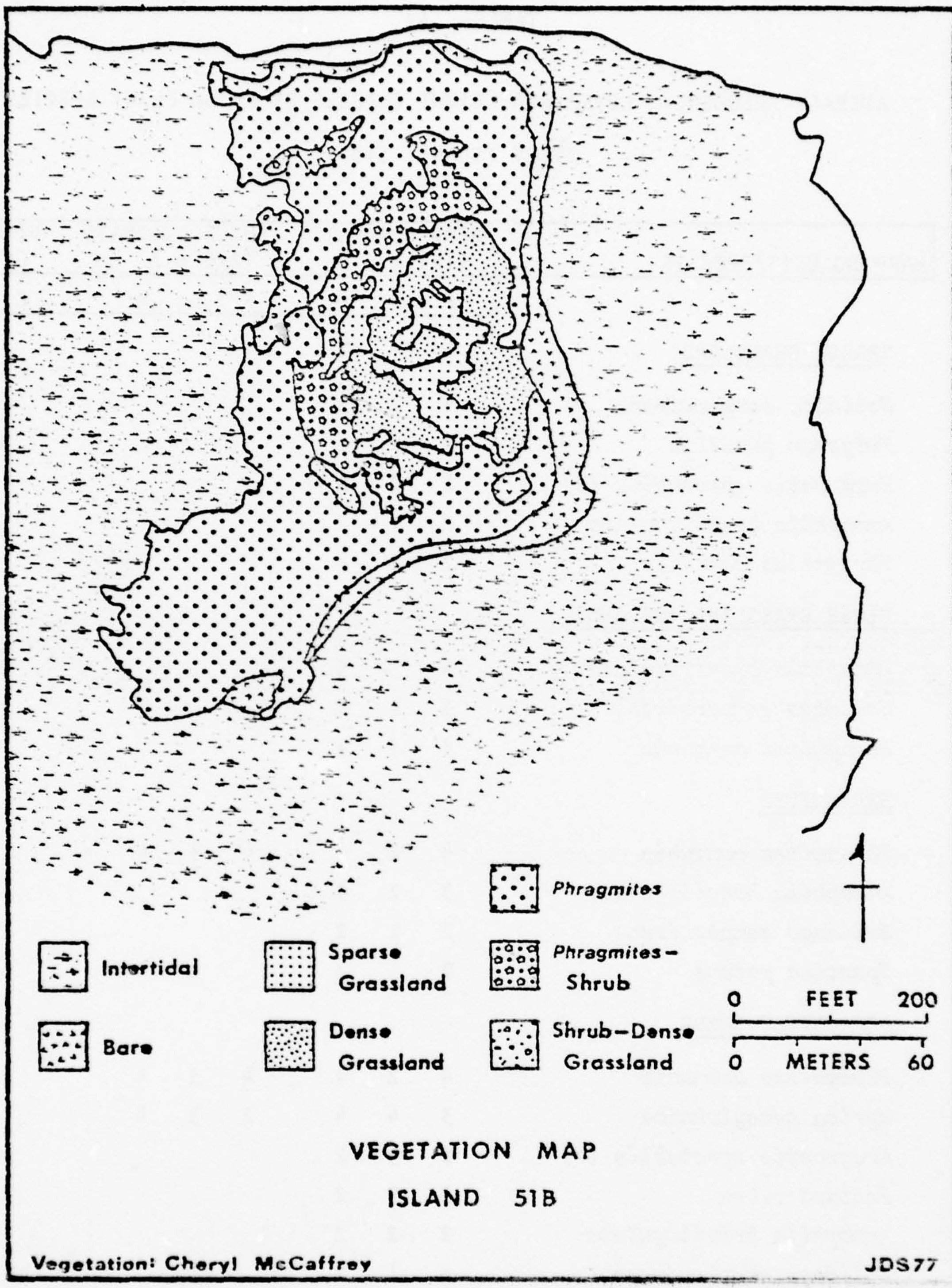

Figure 44. New Jersey dredged material island #51B vegetation map.

TABLE 43.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 51B

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>SPARSE GRASSLAND</u>								
Solidago sempervirens	4	2	2					
Erigeron pusillus	3	2	1					
Eragrostis spectablis (?)	2	2	2					
Ammophila breviligulata	2	2	2					
Phragmites communis	2	1	4					
<u>DENSE GRASSLAND (UPLAND)</u>								
Ammophila breviligulata	4	3	3					
Solidago sempervirens	3	2	2					
Phragmites communis	3	1	3					
<u>*PHRAGMITES*</u>								
Phragmites communis	4	2	4	4	3	4		
Ammophila breviligulata	3	2	3					
Solidago sempervirens	2	2	2					
Spartina patens	2	3	2					
<u>*PHRAGMITES*-SHRUB</u>								
Phragmites communis	4	2	4	4	3	4		
Myrica pensylvanica	3	4	4	2	3	4		
Eragrostis spectablis (?)	2	3	2					
Festuca rubra	2	3	2					
Ammophila breviligulata	2	2	2					
Solidago sempervirens	1	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 43.(Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 51B

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB-DENSE GRASSLAND								
Phragmites communis	4	2	4	4	2	4		
Spartina patens	4	5	2					
Scirpus americanus	3	1	3					
Solidago sempervirens	2	2	2					
Dead Shrubs *(Baccharis)*	-	-	-	2	2	3		
Festuca rubra	2	5	2					
INTERTIDAL								
Distichlis spicata	4	1	2					
Spartina patens	3	4	2					
Salicornia europaea	2	1	2					
Spartina alterniflora	2	3	2					
Atriplex patula var. *hastata*	2	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 44.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 51B

Deposit Size	4.44 Acres	1.80 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	0.53	0.21	11.8
Sparse Grassland	0.27	0.11	6.0
Dense Grassland	0.56	0.23	12.6
Phragmites	2.52	1.02	56.9
Phragmites-Shrub	0.49	0.20	11.1
Shrub	-	-	-
Shrub-Forest	-	-	-
Shrub-Dense Grassland	0.07	0.03	1.6
Dike	-	-	-
	4.44	1.80	100.0%
Drift (on deposit)	0.16	0.06	3.6
Non-drift deposit	4.28	1.74	96.4%
	4.44	1.80	100.00%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 45.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 51B

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	9.48 +	3.84 +
Tidal Flats	-	-
Edge Drift[2]	< 0.01	< 0.01
Adjacent Drift[3]	-	-
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: A59a (Atlantic County)

151. A59a, located at 39°28' latitude and 74°24' longitude , is part of Brigantine National Wildlife Refuge. It is west of Brigantine Inlet and adjacent to Perch Cove, which was last utilized by the U.S. Army Corps of Engineers, Philadelphia District, for subaqueous disposal of dredged material in 1968. A59a is a dredged material deposit at the tip of the salt marsh abutting Perch Cove, and is nearly 6 acres (2.4 ha.) in size. Elevation of the area was estimated to be not more than 1 meter.

152. The perimeter of the dredged material deposit was covered by a large bare salt flat beyond which there was an expanse of low marsh (Fig. 45). A narrow band of salt marsh surrounded the upland vegetation. The high marsh vegetation mixed with *Iva frutescens* and gradually ascended to a mixture of 2-4 meter high *Phragmites communis, Myrica pensylvanica, Baccharis halimifolia* and *I. frutescens*. The *Phragmites* dominated this association on most of the island (Fig. 46). On the eastern side and at one place on the west side, 4-6 meter high shrubs dominated the *Phragmites*. Several 1.8-3.6 meter high shrub thickets were located throughout the island. The shrub thickets were dominated by *M. pensylvanica* and *B. halimifolia*, though *Rhus radicans* and *P. comminis* were also present. A few *Juniperus virginiana* trees, 3-4.6 meters high, also grew in the thickets. (Tables 46-47).

153. The characteristic seral stage of this study island was a mid seral one. Vegetation, indicative of early and late seral stages, was also present (Table 48).

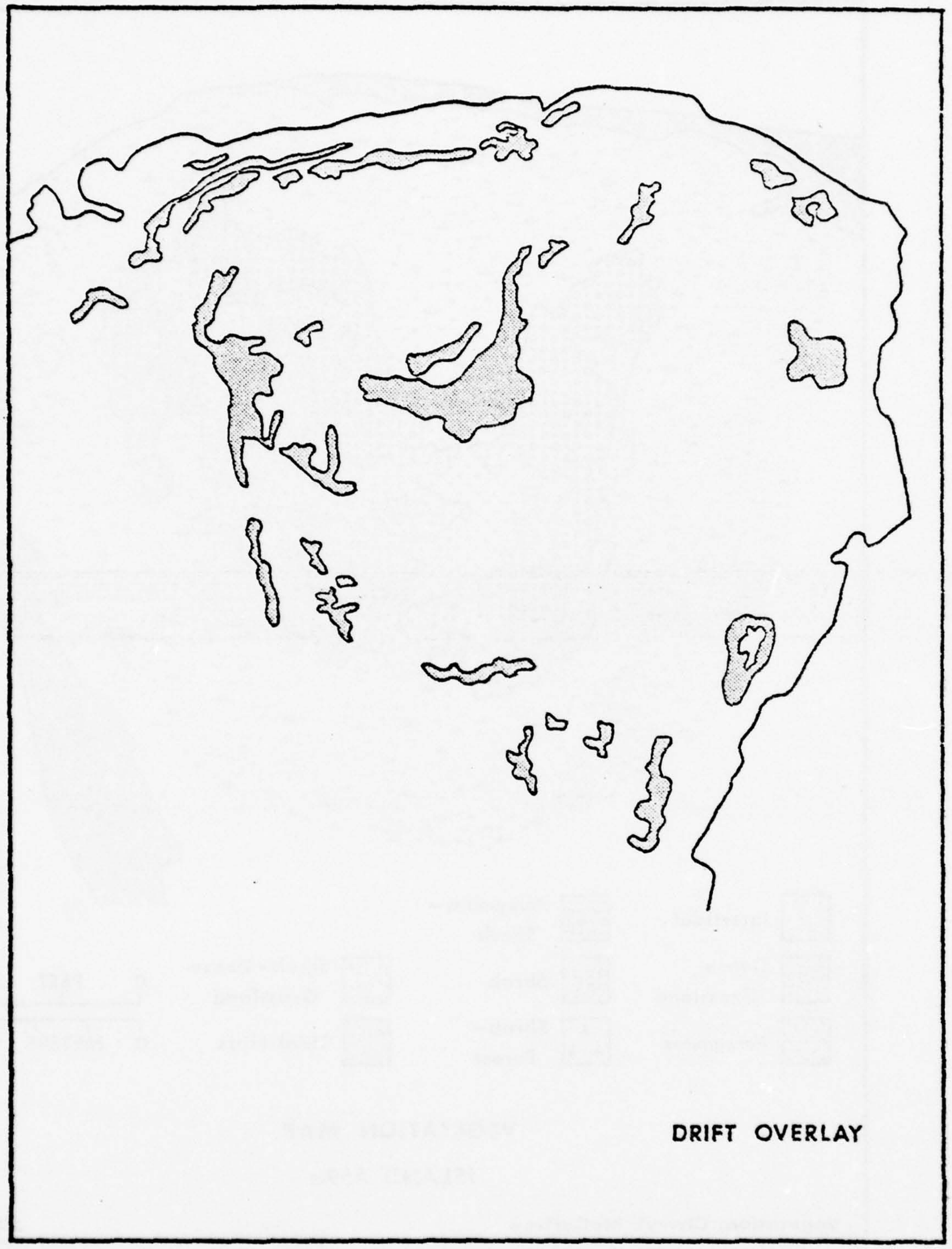

Figure 45. New Jersey dredged material island #A59a drift overlay.

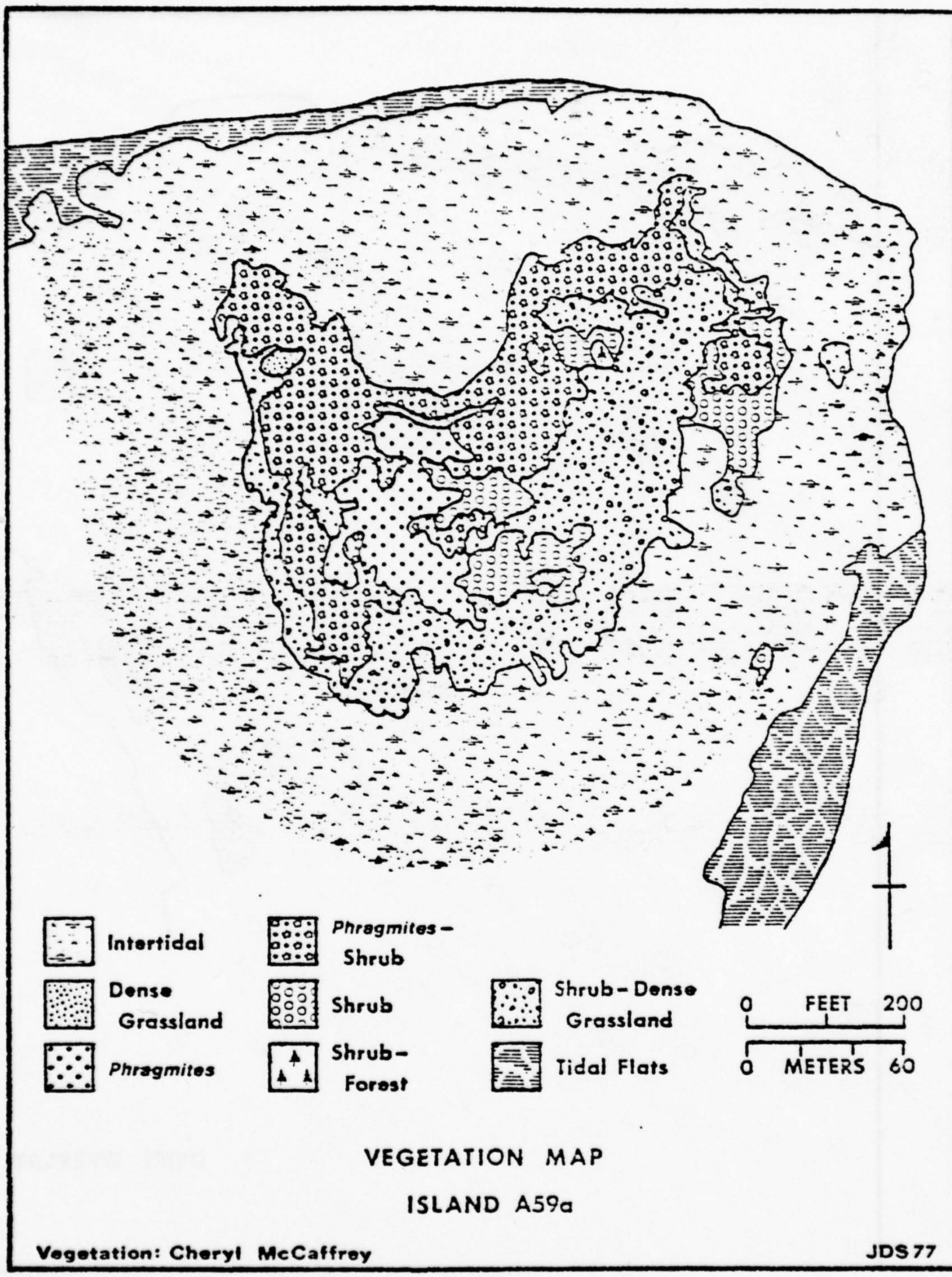

Figure 46. New Jersey dredged material island #A59a vegetation map.

TABLE 46.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: A59a

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>*PHRAGMITES*-SHRUB</u>								
Atriplex patula var. *hastata*							5	2
Iva frutescens							4	4
Phragmites communis							3	5
Baccharis halimifolia							2	5
Myrica pensylvanica							2	5
Rhus radicans							2	2
Spartina patens							1	2
<u>SHRUB</u>								
Spartina patens							5	2
Baccharis halimifolia							4	5
Myrica pensylvanica							4	5
Rhus radicans							3	4
Phragmites communis							2	5
Festuca rubra							1	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 47.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # A59a

Deposit Size	5.85	Acres 2.36	Hectares	-	% of Island
Island Size	-	Acres -	Hectares		

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	0.04	0.01	0.6
Phragmites	0.55	0.22	9.4
Phragmites-Shrub	2.16	0.87	36.9
Shrub	0.69	0.28	11.8
Shrub-Forest	< 0.01	< 0.01	0.2
Shrub-Dense Grassland	2.41	0.97	41.1
Dike	-	-	-
	5.85	2.36	100.0%
Drift (on deposit)	0.46	0.18	7.8
Non-drift deposit	5.39	2.18	92.2
	5.85	2.36	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 48.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #A59a

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	12.64 +	4.97 +
Tidal flats	2.99 +	1.21 +
Edge drift [2]	0.23	0.09
Adjacent drift[3]	0.34	0.14
Adjacent units:[4] (total)	0.05	0.02
Shrub	0.02	0.01
Shrub-dense grassland	0.03	0.01

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping units separated from the deposit within the intertidal area.*

STUDY ISLAND: 78B South (Atlantic County)

154. 78B South, located at 39°19' latitude and 74°34' longitude, is opposite Great Egg Harbor Inlet. Its configuration was linear, giving an elongate and narrow appearance (Fig. 47 and 49). The dredged material deposition, 8.5 acres (3.4 ha.) in size, was on a salt marsh, which is less than 2.7 km. south of Ocean City, New Jersey, and only 1.8 km. from Somer's Point, New Jersey. The dredged material was last deposited in this area in 1969 under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

155. The island was dominated by shrub thickets and a mixture of *Phragmites communis* and shrub species (Fig. 48 and 50). The interior shrub thickets were about 2-4 meters high and dominated by *Myrica pensylvanica, Rhus radicans,* and *Baccharis halimifolia.* Numerous *Juniperus virginiana* trees, 3-6 meters high, were scattered through the shrub thickets. A few stands of *P. communis* were found on the island. Two types of dense grassland were also found: one was dominated by *Ammophila breviligulata* and the other characterized by *Andropogon scoparius, Solidago sempervirens* and *Achillea millefolium.* The salt marsh was bordered by 1-2 meter high *Iva frutescens* often with *Spartina patens* beneath it (Table 49).

156. A mixture of sand and drift supported a varied vegetation on the seaward edge of the dredged material deposit. It was dominated by *Chenopodium album, Cakile edentula, Solidago sempervirens, Ledpidium virginicum* and *Chenopodium ambroscides.* Numerous other species, mostly herbs, and a few grasses and shrubs, also occurred here. Seaward of the beach and drift area, peat or low marsh, were found, depending upon location (Table 50).

157. 78B South was noteworthy for the dominance of *Rhus radicans* and an abundance of *J. virginiana.* Only 98B South had a comparable quantity of *J. virginiana.*

158. This area was characterized by a late seral stage but vegetation indicative of early and mid seral stages was also present (Table 51).

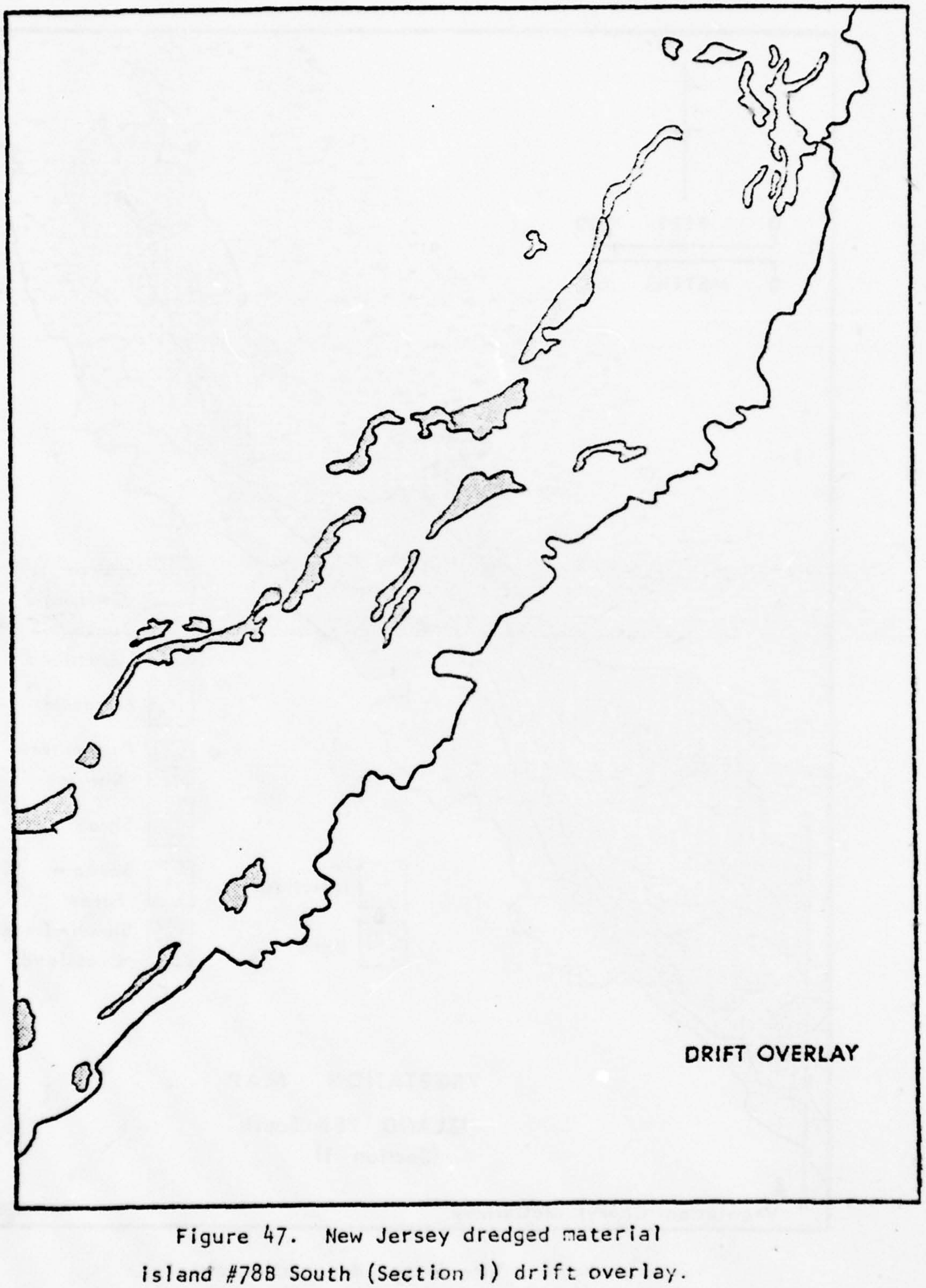

Figure 47. New Jersey dredged material Island #78B South (Section 1) drift overlay.

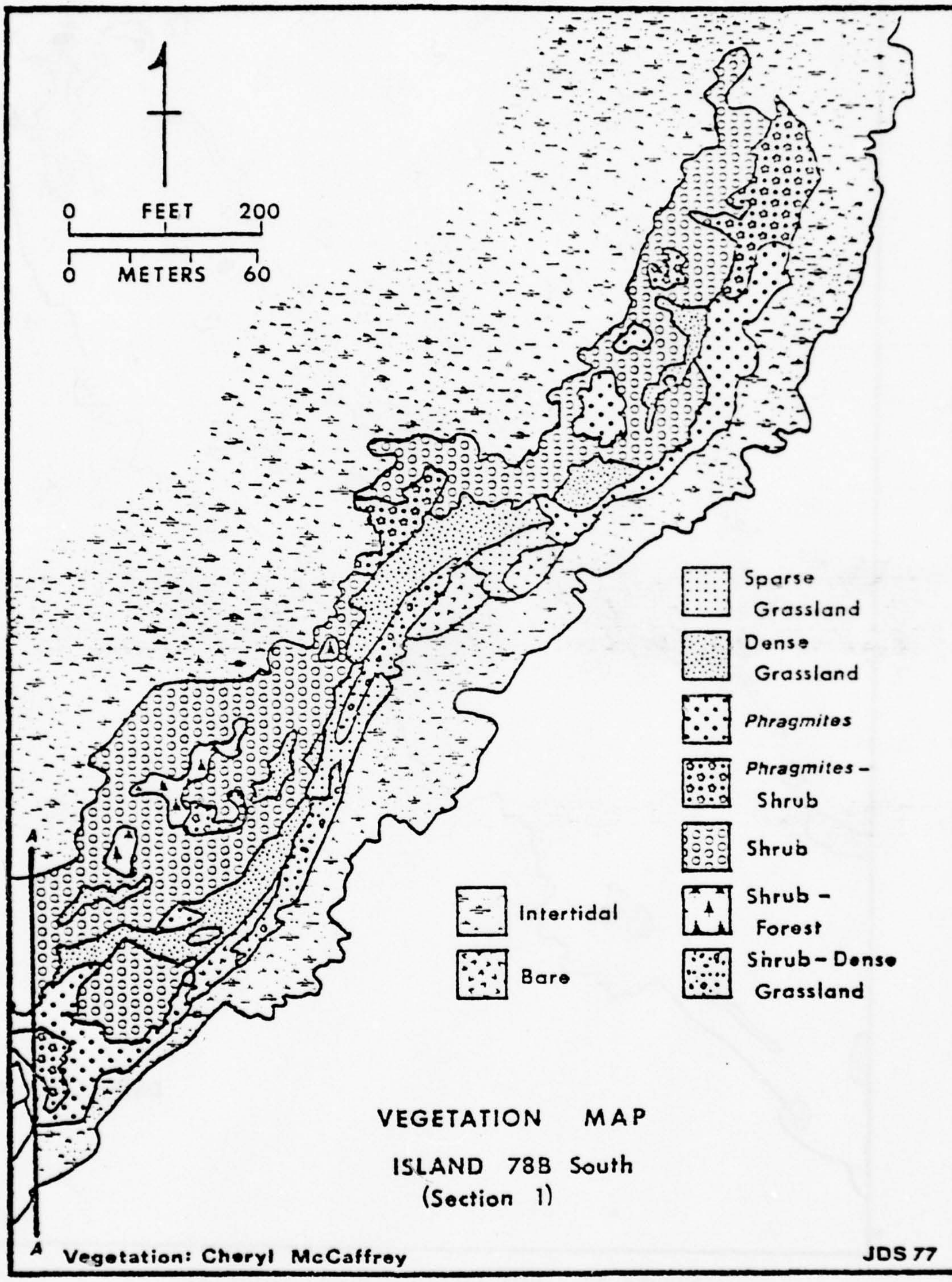

Figure 48. New Jersey dredged material island #78B South (Section 1) vegetation map.

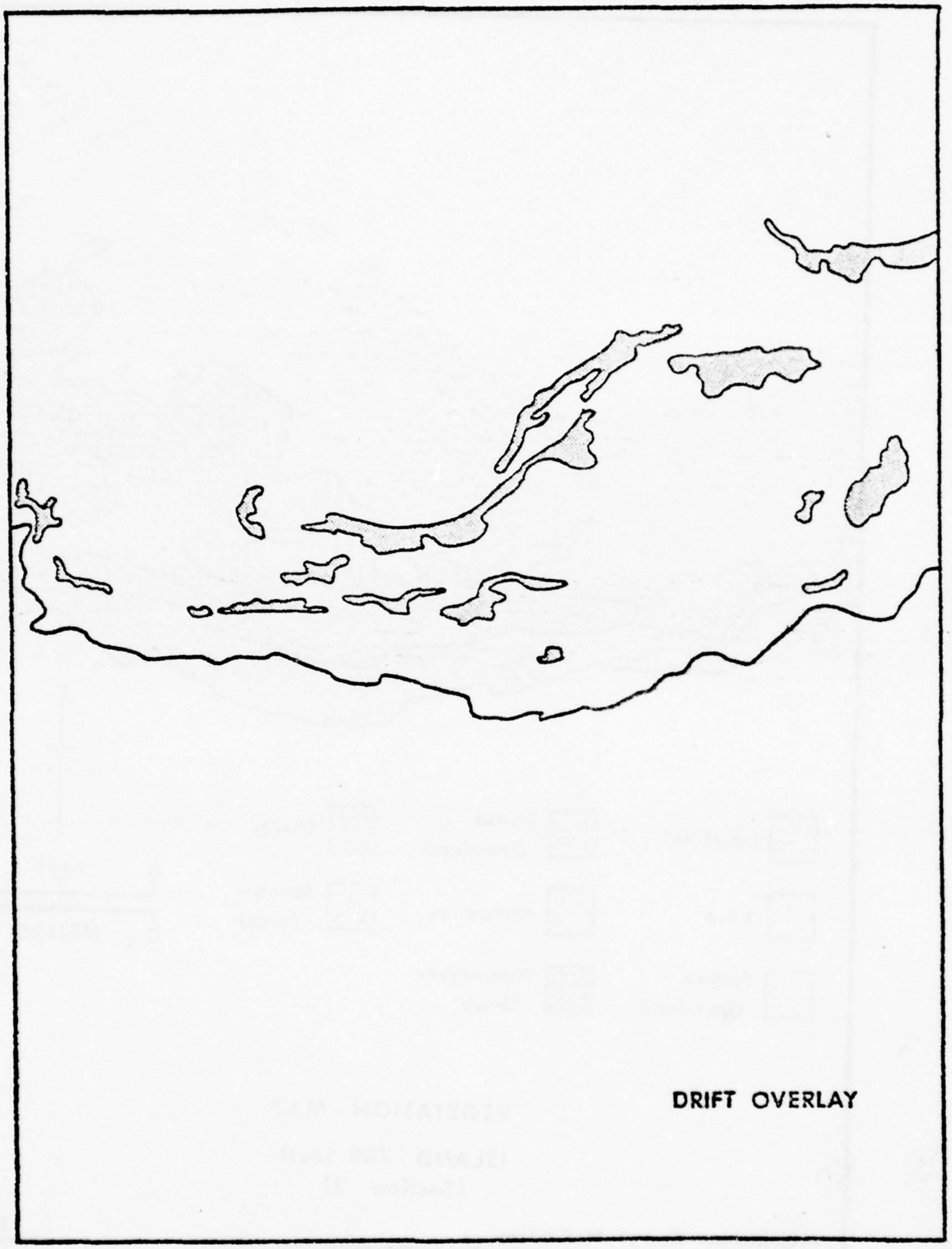

Figure 49. New Jersey dredged material island #78B South (Section 2) drift overlay.

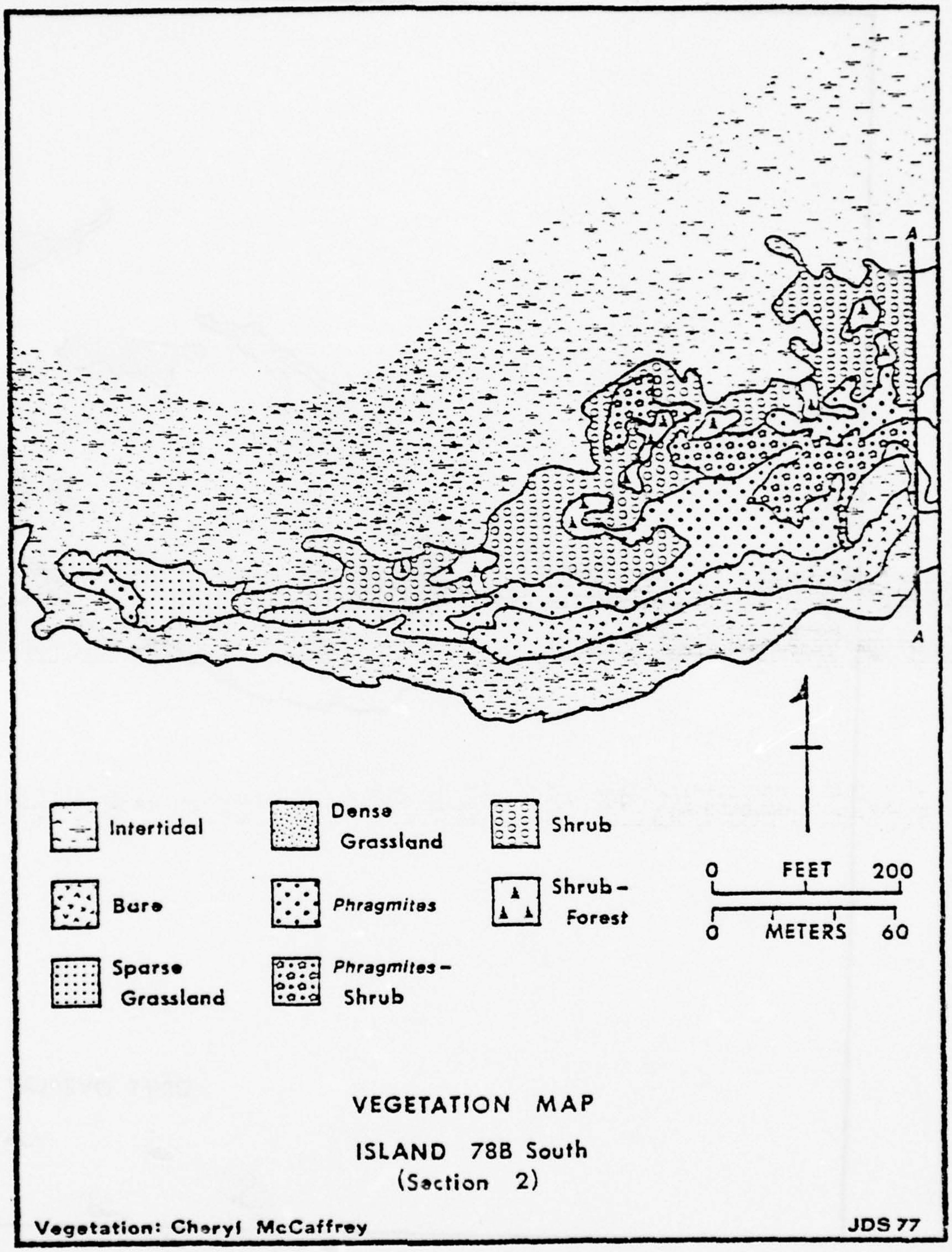

Figure 50. New Jersey dredged material island #78B South (Section 2) vegetation map.

TABLE 49.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 78B South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
BARE-(BEACH)								
Spartina alterniflora	4	3	3					
Cakile edentula							2	2
Chenopodium album							2	2
Lepidium virginicum							2	2
DENSE GRASSLAND (UPLAND)								
Ammophila breviligulata	4	3	3					
Archillea millefolium	1	2	2					
Spartina patens	1	2	2					
Solidago sempervirens	1	2	2					
Myrica pensylvanica	1	3	4	1	2	5		
Phragmites communis	1	1	2					
PHRAGMITES								
Phragmites communis	4	5	4	4	4	4		
Baccharis halimifolia	4	1	3	2	1	4		
Solidago sempervirens	4	2	3					
Spartina patens	4	2	3					
Rhus radicans	-	-	-	3	4	3		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 49. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 78B South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES-SHRUB								
Dead shrubs							3	4
Baccharis halimifolia							1	4
Iva frutescens							1	3
Mrica pensylvanica							1	4
Phragmites communis							1	4
SHRUB								
Myrica pensylvanica	2	4	5	3	4	4		
Rhus radicans	2	2	2	3	4	4		
Baccharis halimifolia	1	4	5	3	4	4		
Iva frutescens	1	4	4	3	4	4		
Dead shrubs	-	-	-	3	4	5		
Festuca rubra	1	3	2					
SHRUB-FOREST								
Rhus radicans	4	4	5					
Myrica pensylvanica	4	3	5					
Iva frustescens	2	2	4					
Juniperus virginiana	-	-	-	2	1	6		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 50.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 78B South

Deposit Size	8.49 Acres	3.45 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	0.70	0.28	8.2
Sparse Grassland	0.47	0.19	5.5
Dense Grassland	0.66	0.27	7.8
Phragmites	1.40	0.57	16.5
Phragmites-Shrub	0.89	0.36	10.5
Shrub	3.89	1.58	45.9
Shrub-Forest	0.20	0.08	2.3
Shrub-Dense Grassland	0.19	0.08	2.2
Dike	-	-	-
Intertidal (within deposit)	0.09	0.04	1.1
	8.49	3.45	100.0%
Drift (on deposit)	0.34	0.14	4.0
Non-drift deposit	8.15	3.31	96.0
	8.49	3.45	100.0%

1. *percentages are based upon dot counts determined by use of a dot grid.*

TABLE 51.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 78B South

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	16.51 +	6.68 +
Tidal Flats	-	-
Edge Drift[2]	0.79	0.32
Adjacent Drift [3]	0.06	0.02
Adjacent Units [4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 85C (Cape May County)

159. 85C, located at 39°14' latitude and 74°39' longitude, is a diked, dredged material island, about 1.8 km. northwest of Corson Inlet and just north of study island 85dmi. A salt marsh, and approximately 1 km., separates the study island from a beach development at the south end of Peck Beach. The dredged material deposit is 9.8 acres (4 ha.) in size and was last used for deposition in 1976, under the auspices of the U. S. Army Corps of Engineers, Philadelphia District. As was the case with study island 45A, the 1976 dredged material depositon appeared to have covered only part of the dredged material deposit already there (Fig. 51).

160. The diked area was only about 1.5 meters high and 1 meter wide. It supported a varied, mostly herbaceous, vegetative community (Fig. 52). *Phragmites communis* was dominant, with *Phytolacca americana, Strophostyles helvola* and *Festuca rubra* also common. Inside the dike was an essentially bare expanse of the most recently dredged sediments. The substrate here was sand, with blue mussel shell in some places. Open water was found on the southern end and caked mud lined the two adjoining deposit sides. Most of 85C was covered by a dense stand of *P. communis*, 1.8-3 meters high. At the center of the *Phragmites* covered area was an open area, of higher elevation (possibly the apex of earlier deposits). This central portion had a variety of plant species and growth forms, dominated by 1-2 meter high *Phragmites*. *Andropogon scoparius, Oenothera biennis, Achillea millifolium* and *Festuca rubra* composed the herb layer. *Erigeron pusillus* and *Vulpia octoflora* were found here also (they were also present on study islands A12 and 51B). They may have been relicts from an earlier successional stage of this deposit. Numerous shrubs were scattered throughout this open area. Species included *Baccharis halimifolia, Myrica pensylvanica, Rhus copallina,* a few *Juniperus virginiana,* and some *Rhus radicans*. This was also the only location where specimens of *Acer rubrum* and *Vitis aestivalis* were found. A few other open places with similar vegetation were found randomly within the *Phragmites* (Tables 53-54).

161. On the northern end of the island, an area of live and dead

Phragmites which had been subjected to approximately 0.6 meter of sand burial was found. Some dead *B. halimifolia* bushes, also buried by sand, were found in this area as well. The sand appeared to have been from aeolian transport.

162. This study island was characterized by an early seral stage but mid seral stage vegetation was also present (Table 54).

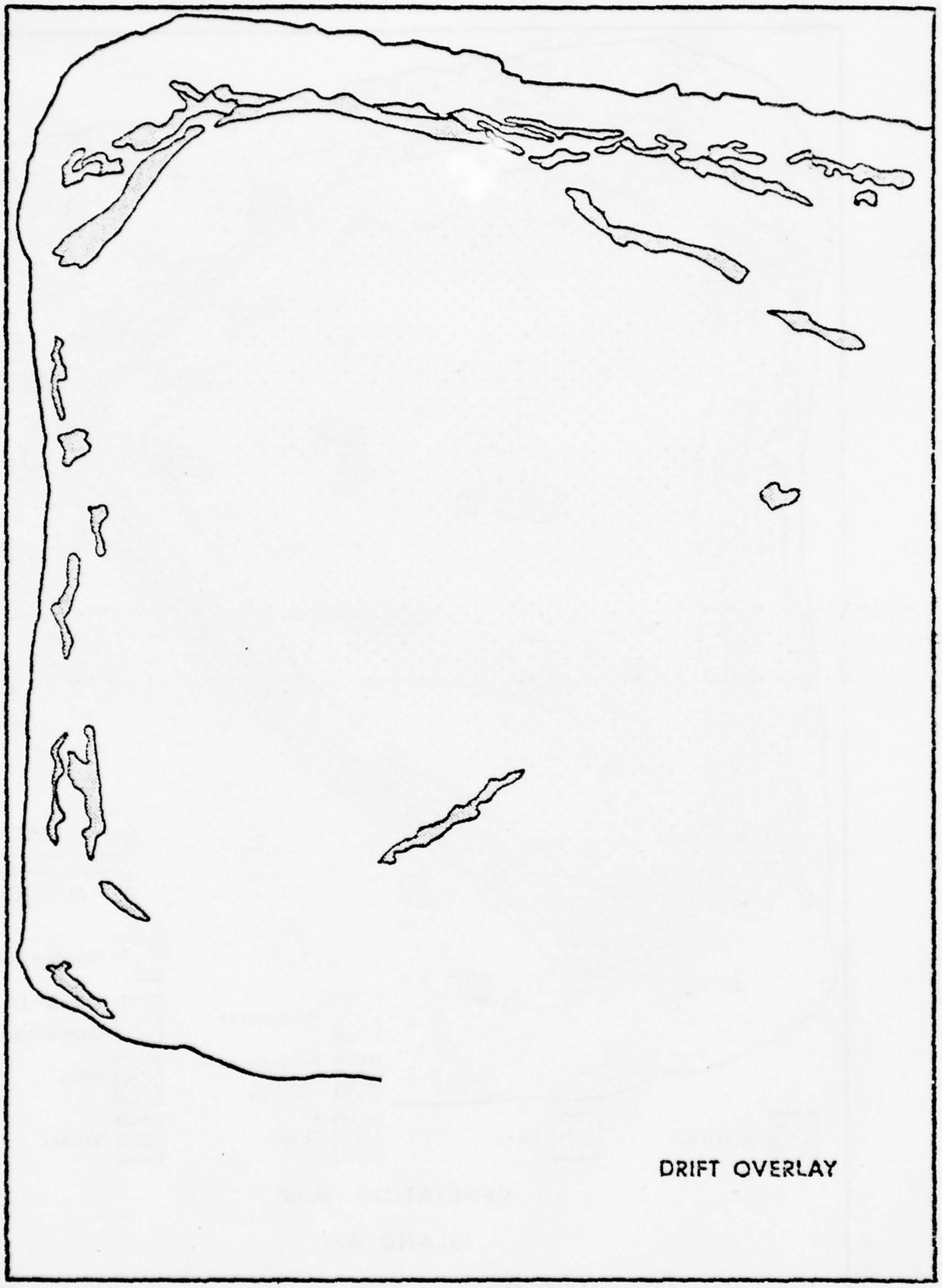

Figure 51. New Jersey dredged material island #85C drift overlay.

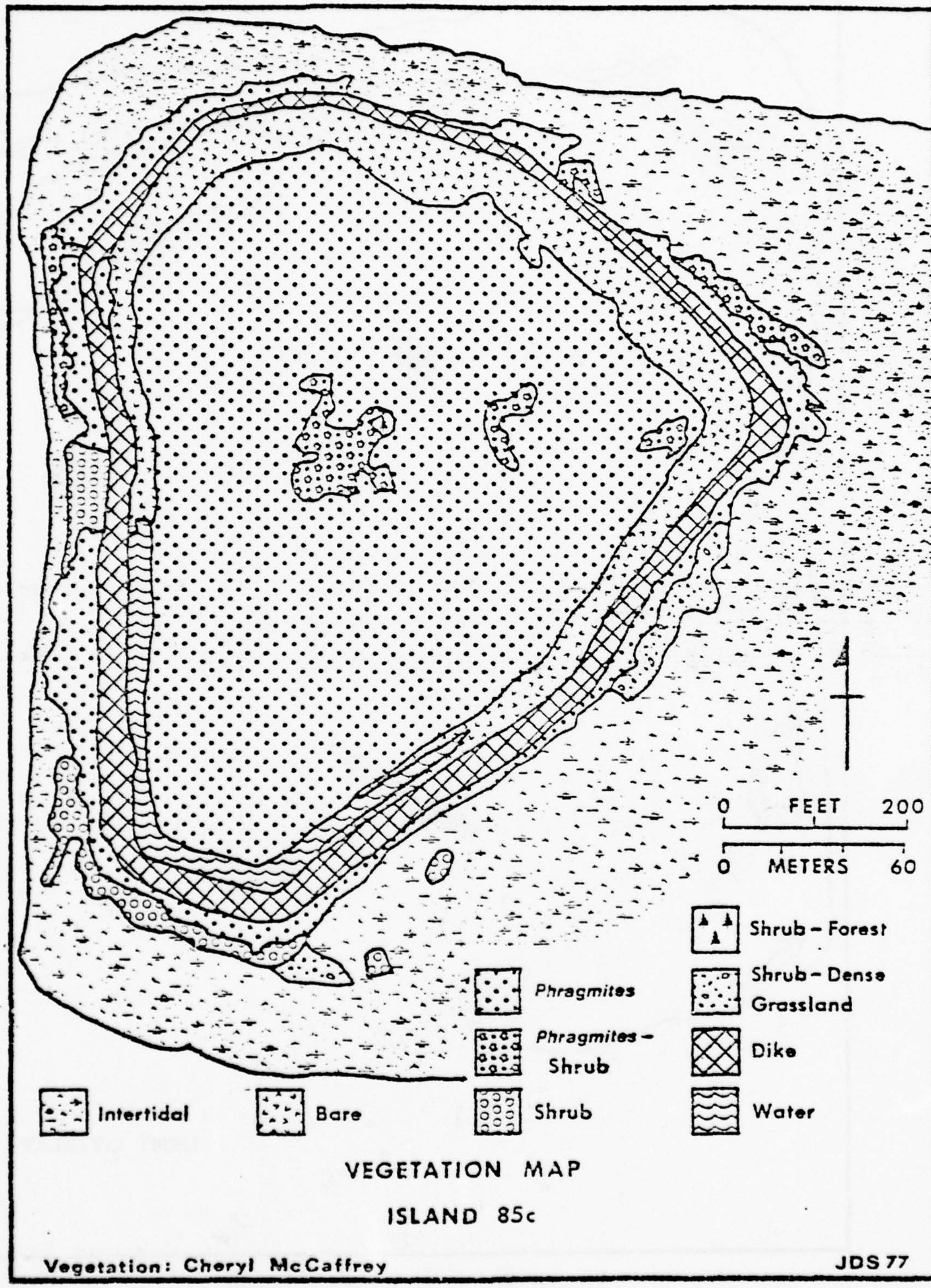

Figure 52. New Jersey dredged material island #85C vegetation map.

TABLE 52.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 85C

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
BARE (DIKE)								
Phragmites communis							1	2
PHRAGMITES								
Phragmites communis							5	5
PHRAGMITES - SHRUB								
Spartina patens							5	2
Phragmites communis							4	4
Baccharis halimifolia							3	5
Dead shrubs							3	4
Rhus radicans							3	2
Andropogon scoparius							2	2
Myrica pensylvanica							2	5
Rhus copallina							2	3
Solidago sempervirens							1	2
DIKE								
Phragmites communis							3	4

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 53.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #85C

Deposit Size	9.79 Acres	3.96 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	1.61	0.65	16.6
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	6.26	2.53	63.9
Phragmites-Shrub	0.22	0.09	2.2
Shrub	-	-	-
Shrub-Forest	< 0.01	< 0.01	< 0.1
Shrub-Dense Grassland	-	-	-
Dike	1.35	0.55	13.8
Water (impounded)	0.35	0.14	3.6
	9.79	3.96	100.0%
Drift (on deposit)	0.21	0.08	2.1
Non-drift deposit	4.58	3.88	97.4
	9.79	3.96	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 54.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #85C

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	8.06 +	3.26 +
Tidal flats	0.35 +	0.14 +
Edge drift [2]	0.28	0.11
Adjacent Drift [3]	0.02	0.01
Adjacent Units:[4] (total)	1.92	0.76
Shrubs	0.33	0.13
Shrub-dense grassland	0.21	0.08
Phragmites	1.20	0.48
Phragmites-shrub	0.18	0.07

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 85 South (Cape May County)

163. 85 South, located at 39°15' latitude and 74°39' longitude, is less than 1 km. from the barrier beach and about the same distance northwest from Corson's Inlet. It is south of study island 85dmi, and surrounded by small creeks and salt marsh. The size of the dredged material deposit is 1.7 acres (0.7 ha.) and it was last utilized for dredged material deposition in 1966, under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

164. A ring of salt pannes, extending from the low salt marsh, bordered the dredged material deposit (Fig. 53). The periphery of the upland area was dominated by an open area of *Iva frutescens*, 1 meter high and with a dense ground cover of high marsh species, dominated by *Juncus gerardi*. Scattered *Phragmites communis* was found with the *Juncus* (Fig. 54).

165. A band of *Phragmites communis*, 1-1.5 meters high, mixed with *I. frutescens*, *Baccharis halimifolia*, and *Myrica pensylvanica*, all approximately the same height, and *J. gerardi* and *Festuca rubra*, dominated the herb layer inside the periphery.

166. The center of the deposit area had a slight elevation, approximately 0.5 meters, and was covered with shrubs. Dominated by *M. pensylvanica* and *B. halimifolia*, 2-3 meters high, *Phragmites*, of similar height, was also found scattered through the thickets. *Rhus copallina* and *R. radicans* were also common. Occasional 2-4 meters high *Juniperus virginiana* were also present (Tables 55-56).

167. Vegetation here was characterized by a late seral stage, though plant communities indicative of mid seral stages were also present (Table 57).

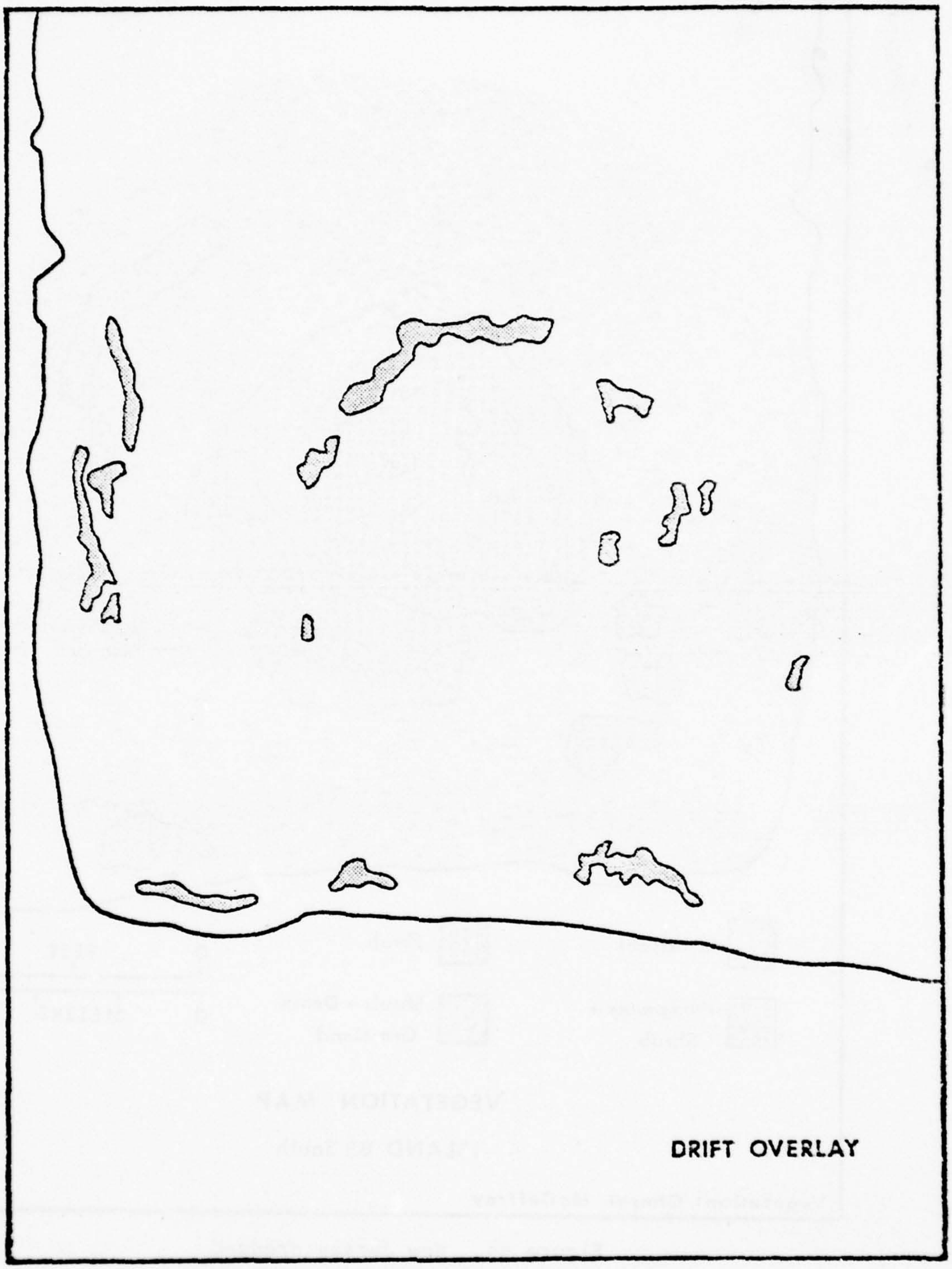

Figure 53. New Jersey dredged material island #85 South drift overlay.

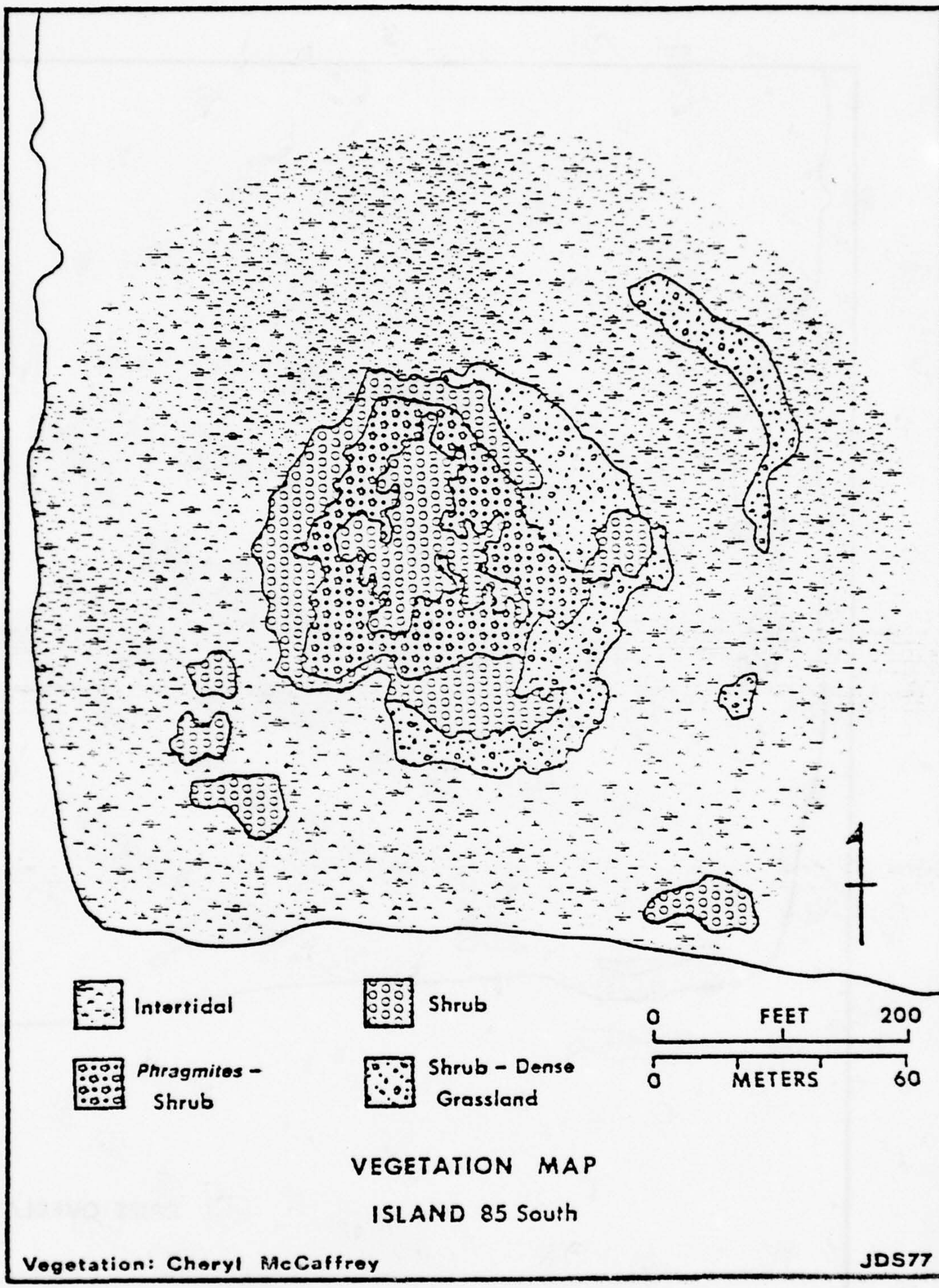

Figure 54. New Jersey dredged material island #85 South vegetation map.

TABLE 55.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 85 South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
<u>*PHRAGMITES*-SHRUB</u>								
Phragmites communis	4	2	4	2	2	4		
Juncus gerardi	4	4	2					
Iva frutescens	3	2	3	4	2	4		
Baccharis halimifolia	3	2	4	3	3	4		
Myrica pensylvanica	2	1	3	3	2	4		
Shrub seedlings	3	3	1					
Solidago sempervirens	3	1	2					
<u>SHRUB</u>								
Festuca rubra	4	4	2					
Phragmites communis	3	2	5	4	2	4		
Myrica pensylvanica	3	4	4	3	4	5		
Baccharis halimifolia	2	2	5	2	3	4		
Rhus copallina	2	2	4	2	3	3		
Achillea millefolium	2	2	3					
Iva frutescens	1	3	3	2	3	3		
Rhus radicans	1	2	2	1	2	3		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 55. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 85 South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SHRUB-DENSE GRASSLAND								
Iva frutescens	4	4	2	4	3	3		
Iva seedlings	4	3	1					
Juncus gerardi	4	3	2					
Salicornia europaea	4	3	1					
Limonium nashii	4	1	2					
Phragmites communis	2	1	3					
Spartina alterniflora	2	1	2					
INTERTIDAL								
Spartina alterniflora	4	2	2					
Salicornia virginica	2	4	2					
Salicornia europaea	2	1	2					
Limonium nashii	2	2	2					
Spartina patens	2	2	2					
Salicornia bigelovii	2	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 56.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND # 85 South

Deposit Size	1.74 Acres	0.70 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	-	-	-
Phragmites-Shrub	0.53	0.22	30.5
Shrub	0.70	0.28	40.4
Shrub-Forest	-	-	-
Shrub-Dense Grassland	0.51	0.20	29.1
Dike	-	-	-
	1.74	0.70	100.0%
Drift (on deposit)	0.04	0.02	2.5
Non-drift deposit	1.70	0.68	97.5
	1.74	0.70	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 57.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #85 South

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.96 +	2.82 +
Tidal Flats	-	-
Edge Drift[2]	0.02	<0.01
Adjacent Drift [3]	0.05	0.02
Adjacent Units:[4] (total)	0.32	0.13
Shrub	0.16	0.07
Shrub-dense grassland	0.16	0.06

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

STUDY ISLAND: 108B (Cape May County)

168. 108B, located at 39°00' latitude and 74°50' longitude, is about 3.2 km. southwest of Hereford Inlet and is on the edge of Richardson Sound. The island is approximately 7 acres (2.8 ha.) in size and the dredged material deposit upon it was approximately 0.5 acres (0.2 ha.) (Fig. 55). The island was last used for dredged material deposition in 1965, under the auspices of the U.S. Army Corps of Engineers, Philadelphia District.

169. The island is surrounded by salt marsh, shallow water and in some areas, tidal flats. The dredged material deposit is dominated by 1-2 meter high stands of *Phragmites communis* (Fig. 56). A band of *Iva frutescens* and *Atriplex patula* var. *hastata* mixed with *Phragmites* nearly surrounded the central stand of *Phragmites*. The northern side of the deposit had a band of *I. frutescens* and high marsh species, which were dominated by *Spartina patens*. The *Iva* and *Phragmites* sections were separated by a band of drift vegetation (Tables 58-59).

170. The vegetation on this island was characterized by an early stage of succession but mid seral stage vegetation was also present (Table 60).

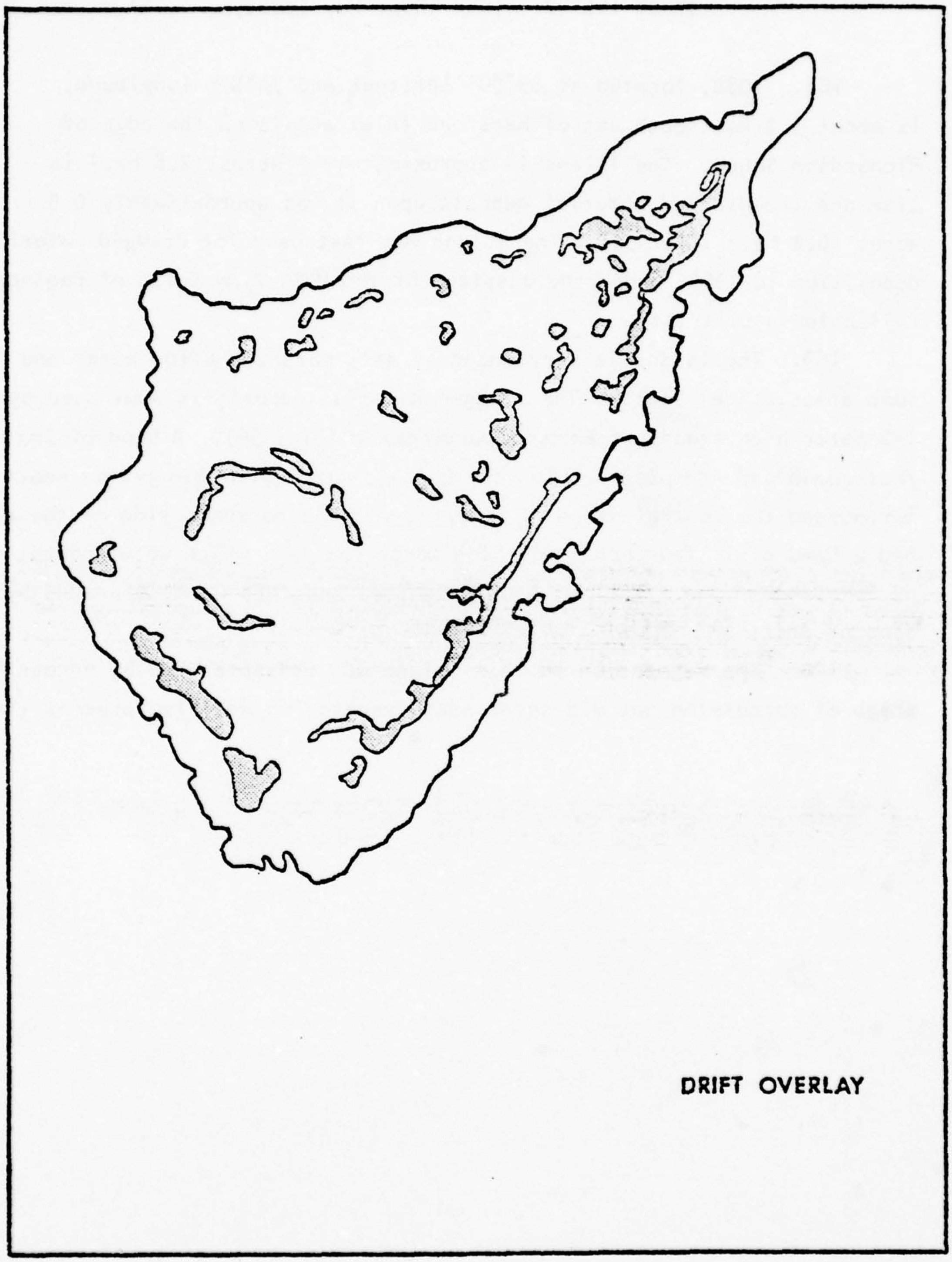

Figure 55. New Jersey dredged
material island #108B drift overlay.

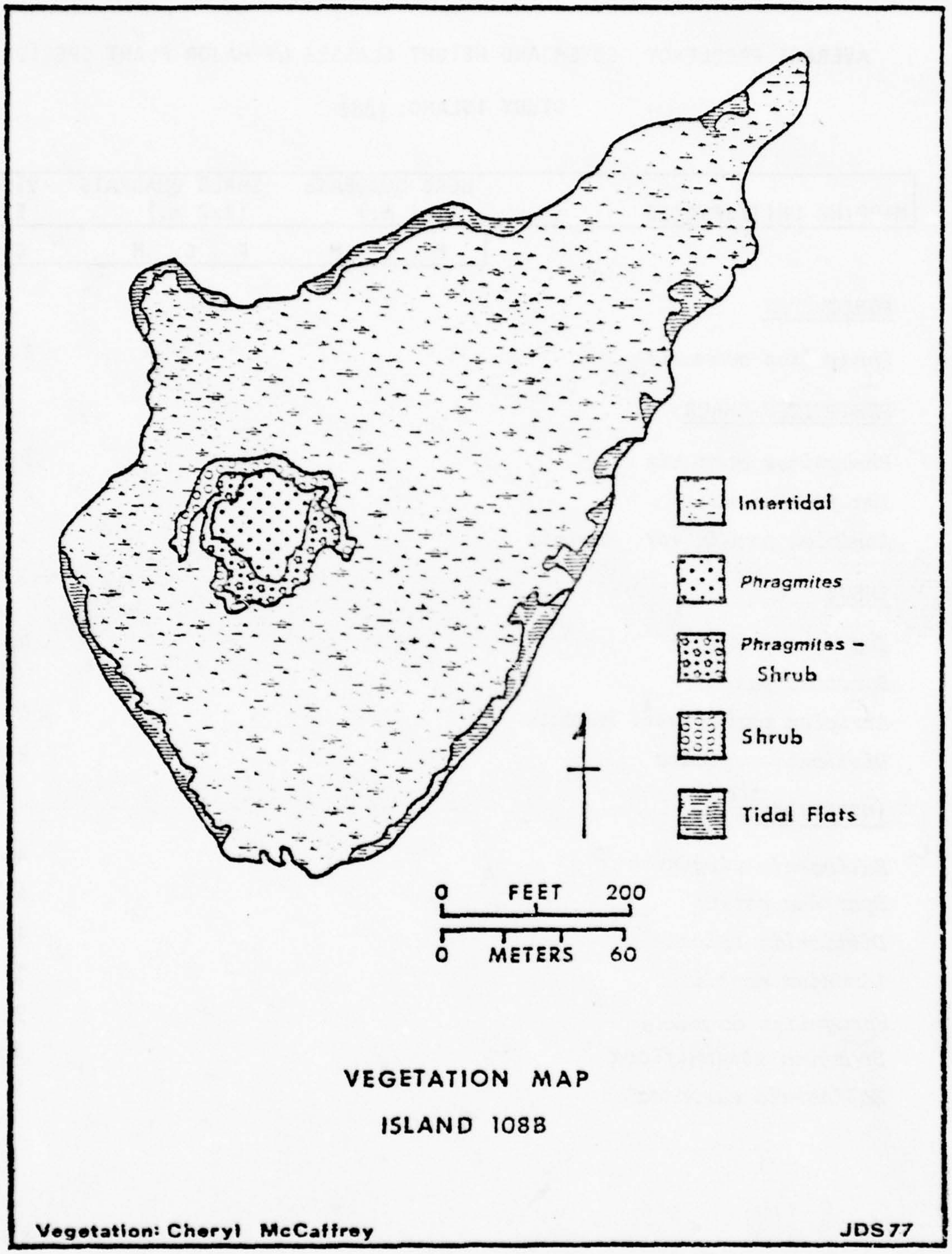

Figure 56. New Jersey dredged material island #108B vegetation map.

TABLE 58.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 108B

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES								
Phragmites communis							5	4
PHRAGMITES-SHRUB								
Phragmites communis							5	4
Iva frutescens							4	4
Atriplex patula var. *hastata*							3	2
SHRUB								
Iva frutescens							5	4
Spartina patens							5	2
Atriplex patula var. *hastata*							4	2
Distichlis spicata							4	2
INTERTIDAL								
Salicornia virginica							4	2
Spartina patens							4	2
Distichlis spicata							3	2
Limonium nashii							3	2
Phragmites communis							3	4
Spartina alterniflora							3	2
Salicornia europaea							1	2

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 59.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #108B

Deposit Size	0.41 Acres	0.16 Hectares	5.85% of Island
Island Size	7.03 Acres	2.84 Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	-	-	-
Dense Grassland	-	-	-
Phragmites	0.18	0.07	44.6
Phragmites-Shrub	0.13	0.05	30.8
Shrub	0.10	0.04	24.6
Shrub-Forest	-	-	-
Shrub-Dense Grassland	-	-	-
Dike	-	-	-
	0.41	0.16	100.0%
Drift (on deposit)	< 0.01	< 0.01	1.5
Non-drift deposit	0.41	0.16	98.5
	0.41	0.16	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 60.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND # 108B.

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	6.67	2.68
Tidal Flats	0.43	0.17
Edge Drift[2]	0.02	<0.01
Adjacent Drift[3]	0.40	0.16
Adjacent Units[4] (total)	-	-

1. Plant communities occurring outside the deposit boundary on the island;
2. Drift located at the interface of the deposit and the intertidal;
3. Drift scattered in the intertidal area well beyond the deposit boundary;
4. Mapping Units separated from the deposit within the intertidal area.

STUDY ISLAND: 109 South (Cape May County)

171. 109 South, located at 38°59' latitude and 74°51' longitude, is about 3 km. north of Cape May Inlet and 6.4 km. south of Hereford Inlet. The dredged material deposit is on a salt marsh opposite Wildwood Crest, New Jersey. It is almost 5 acres (2 ha.) in size and the last dredged material deposition date for this site is unknown. However, dredged material deposition at unspecified sites in this area occurred in 1965 under the auspices of the U. S. Army Corps of Engineers, Philadelphia District (Fig. 57).

172. The island is adjacent to boating channels and heavy wakes (0.6 m. or more) left by boat traffic are eroding the salt marsh edges in the area. 109 South had a small sandy beach, which was subjected to heavy recreational use from passing boaters.

173. The deposit area, was vegetated on the south side by *Phragmites communis*, about 2.1 meters in height. In some areas, *Rhus copallina*, *Baccharis halimifolia*, *Myrica pensylvanica*, and *Sambucus canadensis*, were co-dominant with *Phragmites*. A few 3 meters high *Prunus serotina* and *Juniperus virginiana*, 3.6 meters high, were also found here (Tables 61-62).

174. The northern part of this upland was characterized by *Lonicera japonica*, which seemed to be draped over all vegetation (Fig. 58). Dense grasslands of *Panicum lanuginosum*, *Andropogon scoparius*, *A. virginicus* and *Achillea millefolium* were found on the northeast side of this area. However, these grasslands had been invaded by shrubs (*R. coppalina*, *B. halimifolia*, *M. pensylvanica*, *S. canadensis*, *P. communis)* and vines. The viniferous vegetation included *L. japonica*, *Parthenocissus quinquefolia*, and *Rhus radicans*. The *Lonicera* grew not only in the grassland, but also scrambled over dead *Phragmites* stems and skeletons of *B. halimifolia* and was, in large part, impenetrable. 109 South was the only study island which had *L. japonica* as a dominant plant species and in such abundance. It even seemed to be displacing *Phragmites*. Specimens of *Morus alba* and *Sassafras albidum* were also noted on this deposit, and while not the only site with *Sambucus canadensis*, it was especially common.

175. The characteristic seral stage of this deposit was classified as early, but mid and late seral stages were also present (Table 63).

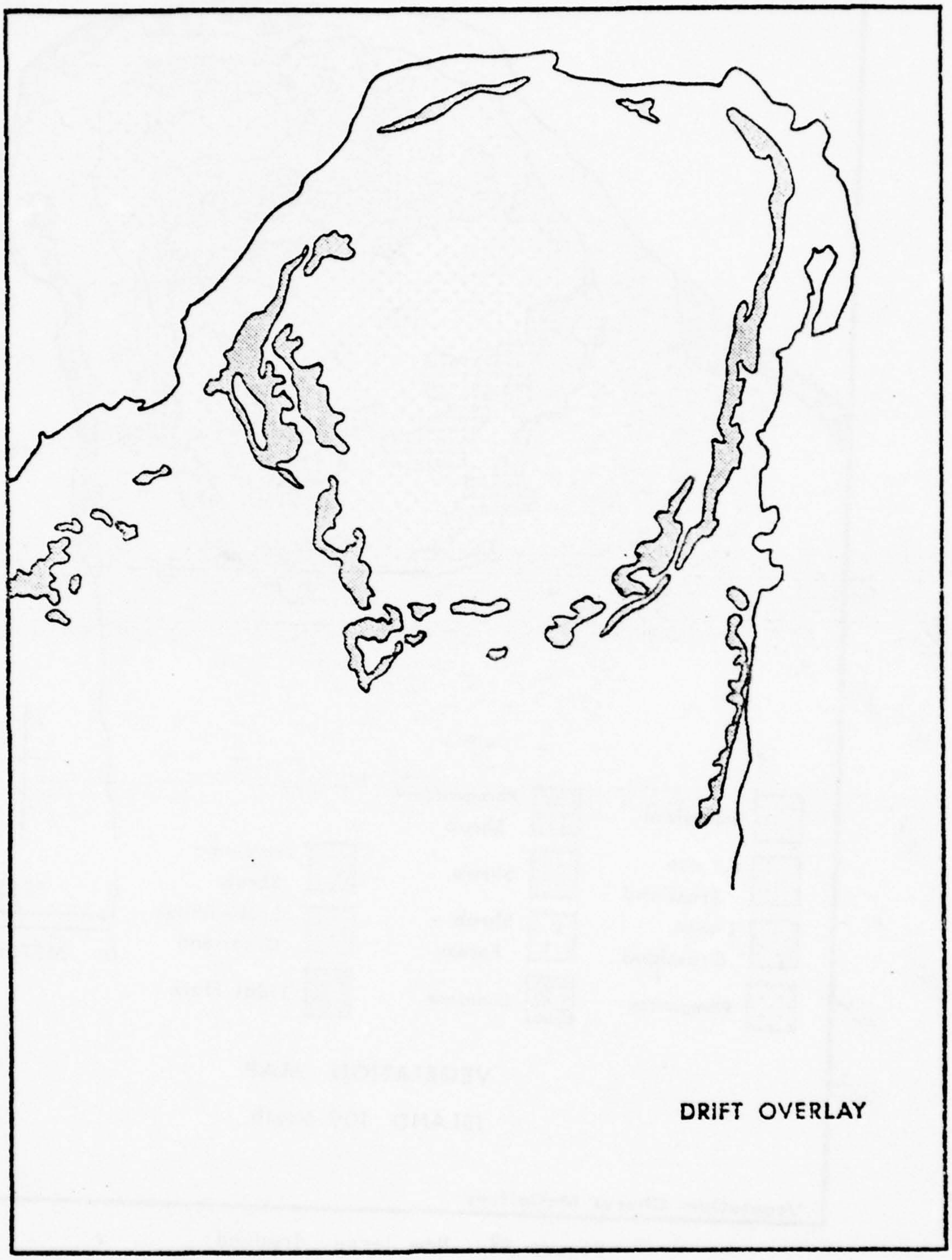

Figure 57. New Jersey dredged
material island #109 South drift overlay.

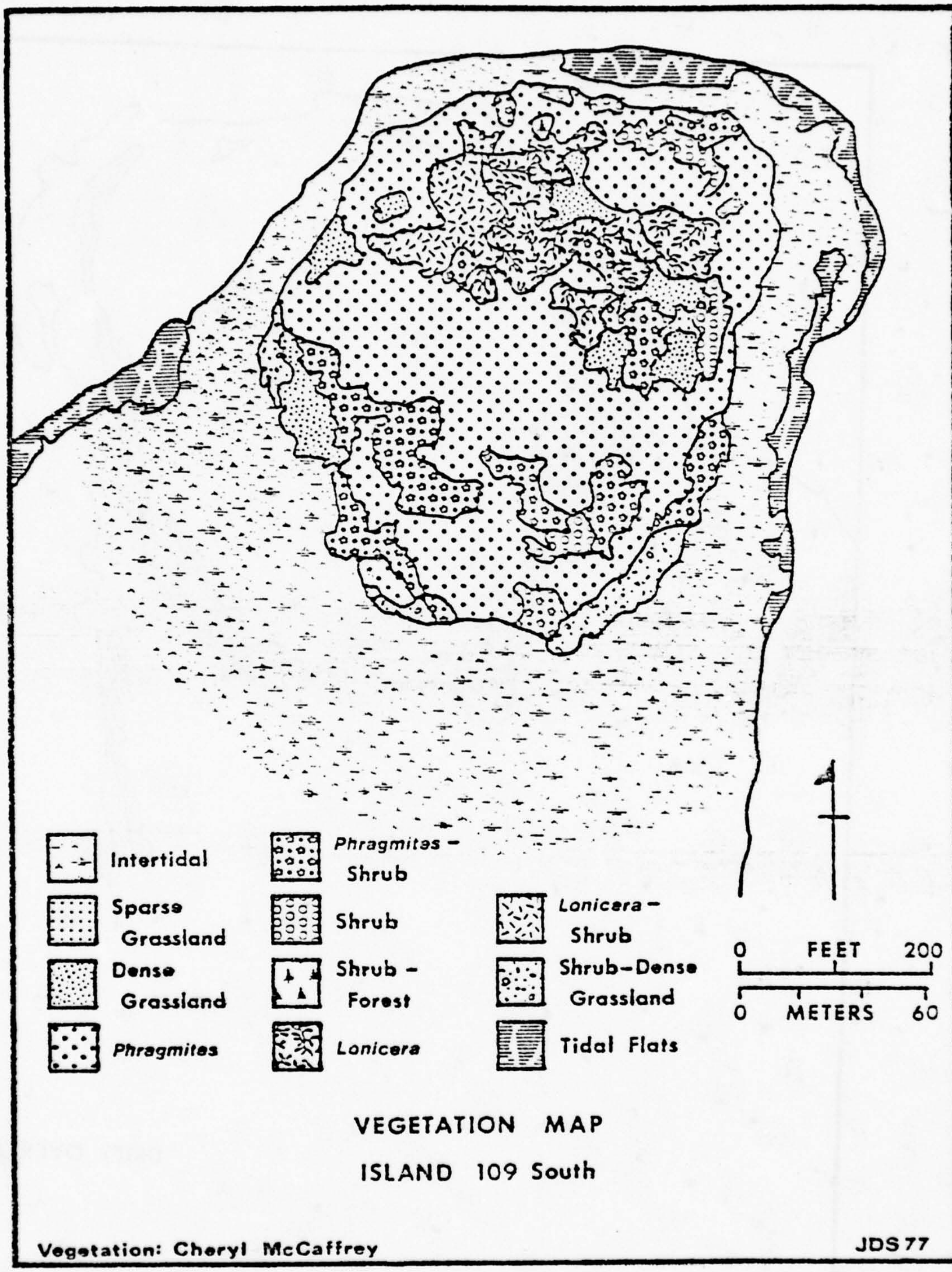

Figure 58. New Jersey dredged material island #109 South vegetation map.

TABLE 61.

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 109 South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
SPARSE GRASSLAND								
Rhus copallina	3	3	2	4	2	3		
Achillea millefolium	3	2	2					
Cyperus sp.	3	1	1					
Phragmites communis	3	1	3					
Vulpia octoflora	3	1	2					
Solidago sempervirens	2	2	2					
DENSE GRASSLAND								
Rhus copallina	4	3	3	4	3	3		
Achillea millefolium	4	3	2					
Solidago sempervirens	4	2	2					
Pharagmites communis	4	1	3	4	2	4		
Solidago altissima	4	2	2					
Andropogon virginicus	3	2	2					
Parthenocissus quinquefolia	2	3	2					
Eupatorium hyssopifolium	2	2	2					
Panicum lanuginosum	2	2	2					
Eupatorium album	2	1	2					
dead shrubs	1	4	5	1	4	5		
Rhus radicans	1	2	2	1	2	2		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 61. (Continued)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 109 South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
PHRAGMITES-SHRUB								
Sambucus canadensis	4	4	5	4	5	5		
Lonicera japonica	4	2	3	4	2	4		
Convovulus sepium	4	2	4					
Phragmites communis	4	1	5	4	1	5		
LONICERA								
Lonicera japonica	4	4	2	3	5	3		
Achillea millefolium	4	2	2					
Dead shrubs	3	2	4	3	2	4		
Solidago altissima	3	1	2					
Baccharis halimifolia	2	2	4	2	2	5		
Rhus radicans	3	2	2	3	2	3		
Parthenocissus quinquefolia	-	-	-	2	3	3		
Rhus copallina	-	-	-	2	2	3		
Panicum lanuginosum	2	1	2					
Andropogon virginicus	2	1	2					

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 61. (Concluded)

AVERAGE FREQUENCY, COVER AND HEIGHT CLASSES OF MAJOR PLANT SPECIES

STUDY ISLAND: 109 South

MAPPING UNIT/SPECIES	HERB QUADRATS (1x1 m.)			SHRUB QUADRATS (2x2 m.)			VISUAL EST.	
	F	C	H	F	C	H	C	H
LONICERA-SHRUB								
Lonicera japonica	4	5	3	4	5	3		
Dead shrubs	3	2	5	4	2	5		
Solidago sempervirens	3	2	2					
Parthenocissus quinquefolia	3	3	3	3	2	3		
Solidago altissima	3	2	3					
Phragmites communis	2	1	4	4	1	4		
Baccharis halimifolia	2	2	5	3	4	4		
Rhus copallina	2	4	4	3	3	4		

F= Frequency Class; C=Cover Class; H=Height Class.

TABLE 62.

DREDGED MATERIAL ISLAND AND MAPPING UNIT AREAS: ISLAND #109 South

Deposit Size	4.89 Acres	1.98 Hectares	- % of Island
Island Size	- Acres	- Hectares	

MAPPING UNIT	ACRES	HECTARES	% OF DEPOSIT[1]
Bare	-	-	-
Sparse Grassland	0.01	<0.01	0.3
Dense Grassland	0.37	0.02	7.5
Phragmites	2.68	1.09	54.7
Phragmites-shrub	0.84	0.34	17.2
Shrub	0.18	0.07	3.7
Shrub-forest	<0.01	<0.01	0.1
Shrub-dense grassland	0.17	0.07	3.6
Dike	-	-	-
Lonicera	0.47	0.19	9.5
Lonicera-shrub	0.16	0.07	3.4
	4.89	1.98	100.0%
Drift (on deposit)	0.20	0.08	4.0
Non-drift deposit	4.69	1.90	96.0
	4.89	1.98	100.0%

1. percentages are based upon dot counts determined by use of a dot grid.

TABLE 63.

SEPARATED MAPPING UNITS AND DRIFT AREAS: ISLAND #109 South

MAPPING UNIT	ACRES	HECTARES
Intertidal[1]	5.92	2.40
Tidal Flats	0.62	0.25
Edge Drift[2]	0.36	0.15
Adjacent Drift[3]	0.27	0.11
Adjacent Units[4]	-	-

1. *Plant communities occurring outside the deposit boundary on the island;*
2. *Drift located at the interface of the deposit and the intertidal;*
3. *Drift scattered in the intertidal area well beyond the deposit boundary;*
4. *Mapping Units separated from the deposit within the intertidal area.*

PART V: PLANT SUCCESSION

176. The determination of plant succession and successional trends for the New Jersey dredged material islands described in this report can be considered only as tentative. Analysis was based upon a relatively small sample of twenty-one study sites investigated only during one field season. The past history of many of these study islands was either unobtainable or of insufficient extent, precluding reliable determination of successional trends within the short time frame allowed for this study. Records from the U. S. Army Corps of Engineers, Philadelphia District, pertaining to deposition of dredged material on specific islands along the New Jersey Intracoastal Waterway were incomplete or non-existent. Study island 85C presents an excellent example of some of these problems. According to available records, this island only received dredged material deposition in 1976. However, unrecorded use of this site was evidenced by the presence of shrubs, surrounded by dense stands of *Phragmites communis*, at the center of the deposit area. This vegetation was clearly older than a one-year old island deposit and would not have occurred at this location, which was typically a salt marsh area, if previous deposition had not taken place. It also would have been obliterated had the entire area indeed been covered over in 1976 by freshly dredged material.

177. Reasonably reliable records exist for thirteen of the study islands and discussion of successional trends is based mostly upon them. Other islands are discussed only if successional relationships could be easily discerned. The islands selected for analysis were utilized as deposition sites from 1963 through 1969, with a six year gap before use again in 1975. Thus a period of early to mid seral stages is precluded from detailed discussion here. A further complicating factor is that the exact location and extent of surface coverage by each dredged material deposition is unknown for each available date of deposition. On islands with a series of depositions pre-dating 1975, accurate determination of

the ages of older plant associations was therefore impossible. Because of this, it was difficult to determine the exact time period overwhich the present vegetative communities have reached their current successional status.

178. Extent of deposition and the age of the dredged material islands is not the only factor influencing plant succession. Cross sectional depth of sediment deposition, ground water availability, soil salinity, salt spray, frequency of and susceptibility to storm inundation (especially areas with little or no elevation), presence or absence of diking, seed availability, and seed transport mechanism are all factors that should be considered when dealing with plant succession. Unfortunately, these factors were not programmed to be a part of this study. All of the above factors plus others not listed here, but nonetheless essential to the proper determination of plant successional trends over a period of time, indicated that the successional trends listed in this report can only be accepted as tentative. Considerable research over several years in New Jersey is needed to determine the successional trends of vegetation on dredged material sites in New Jersey with any great degree of surety.

EARLY SERAL STAGES (MAPPING UNITS: BARE, SPARSE GRASSLAND, DENSE GRASSLAND, *PHRAGMITES*)

179. The vegetative communities classified as representing an early seral stage on dredged material islands in New Jersey varied with the deposition patterns on the islands studied: diked, domed, or spread in a low profile. Because of these configurational differences, their early successional stages also differed.

180. On diked study islands, sediments deposited behind the dike were essentially unvegetated for at least two years. The dike probably restricted the introduction of colonizing seeds and rhizomes carried by tides and storms under natural conditions. Some of the first plants found on "early seral" stage diked study islands were the halophytes: *Distichlis spicata, Spergularia marina, Suaeda maritima,* and *Sesuvium maritima,* and the "weeds": *Chenopodium album, Atriplex patula* var. *hastata, Poa annua,* and *Phragmites communis.* Salt intolerant species are slower to colonize

these diked dredged material areas because of the higher salinity of the sediments after the salt water portion of the dredged material evaporates. Ponding from rain water and/or flood waters which periodically cover parts of the rim-like depositions and which are retained within the dike would also retard colonization by pioneer species intolerant of standing water.

181. Diked study islands 45A, 85C, and 103 were in early stages of succession. The dikes surrounding the deposits were in more advanced stages of colonization and succession than the areas internally adjacent to them. Central, higher portions were also more vegetated than lower areas surrounding them. *Phragmites communis* seemed to be the most ubiquitous species, colonizing almost all areas on such islands.

182. Several of the study islands (A12, A12 North, X27, 51B) were dome-shaped. They ranged in elevation from under 1 m. to 3 m. above the salt marsh surface. Unfortunately, definite ages for most of them are lacking. The bare sand, shell and/or pebbled areas on the dome top were often invaded by *Cyperus sp.*, *Vulpia octoflora*, *Triplasis purpurea*, *Bromus tectorum*, *Erigeron pusilus* and *Oenothera parviflora*. These species (or combinations of them) formed a sparse grassland community at the highest elevations on several of the domed islands studied and represent an early seral stage on deposits that are at least 12 years old in some instances.

183. At the base of the dome dense grassland was typically found; it was most often composed of *Ammophila breviligulata* and *Solidago sempervirens*. The lower areas were colonized by *P. communis*. Data indicate that over a period of time the dense grassland species ascend the dome followed by *Phragmites*.

184. Many of the same sparse grassland, early seral stage species on the dome tops were also present, though of less importance on 11-14 year old islands deposit summits in mid seral stages and characterized by dense grassland species with some shrub invasion.

185. Vegetation maps suggest that domed deposits take longer to advance beyond an early seral stage of sparse grassland than do islands with flatter or less elevated dredged material dispersal patterns.

186. Most of the dredged material islands in New Jersey, along the Intracoastal Waterway, evidenced a "low profile" configuration. Study islands did not include the earliest seral stages present on this deposit type but *Phragmites communis* is probably a major pioneer species. *Phragmites* advances by rapid rhizome multiplication of culms. It forms tall, dense stands and is one of the earliest and most persistent of all species invading these deposits. Study island 108B, 12 years old, was among the youngest low profile dredged material islands studied, having been last deposited upon in 1965. It was dominated by *Phragmites communis*, which occurred in a single dense stand where some mid seral vegetation growth had begun. Apparently, periodic inundation of low lying dredged material deposits by storm and high tides maintains early seral stages by drowning or salt exposure to the less tolerant woody species, characteristic of later seral stages.

187. On seemingly older low profile dredged material islands (no ages were available), dense grassland of *Ammophila breviligulata*, *Andropogon scoparius*, *Andropogon virginicus* and/or *Panicum virgatum* were found. It was not determinable whether the above species were the initial invaders or had followed earlier sparse grassland species.

188. On some low profile islands, drift (mostly *Spartina alterniflora* and *Phragmites* stems) covered large portions of them. These islands also had characteristic succession patterns which varied somewhat from those islands already described. Study island A35 presents an excellent portrait of a low profile dredged material island in an area where the natural vegetative community is tidal salt marsh, and where most of the surface was covered by drift. The drift was invaded by *Cakile edentula* and *Atriplex patula* var. *hastata*. Areas on the island periphery had *Spartina alterniflora*, *Bassia hirsuta* and *Salsola kali* growing in abundance. Interior portions had an open herbaceous vegetative growth dominated by *Solidago tenuifolia*, *S. sempervirens*, *Lepidium virginicum*, and herbaceous perennial vines, including *Strophostyles helvola* and *Convovulus sepium*.

189. Study islands did not differ in their mid and late seral

stage vegetation to the same extent that they differed in their early seral stages. The following characterizations for these later seral stages apply to the study islands regardless of their configuration.

MID SERAL STAGES (MAPPING UNITS: *PHRAGMITES*-SHRUB, SHRUB-DENSE GRASSLAND)

190. The mid seral stages on the study islands (A59a, 98A, 98B North) were characterized by shrub invasion of sparse grassland, dense grassland or pure *Phragmites* vegetation, also described as early seral stage vegetation. The oldest dredged material deposit which had mid seral vegetation was 9 years old, though transformation to this stage probably begins at an earlier age. Shrubs usually found in this stage were *Myrica pensylvanica, Baccharis halimifolia,* and *Iva frutescens*. *Rhus copallina* was also common on some islands, while *Sambucus canadensis* was occasional.

191. At the central portion of some dredged material islands where dense grassland occurred, the mid seral stage was initiated with the simultaneous advent of both *Phragmites* and shrubs. This situation was often observed on islands that probably had subdomes of lower elevation than the main dome(s) (study islands 45A and 85C). The time period necessary for this occurrence is unknown.

192. Dredged material islands with large areas of drift vegetation were characterized at mid seral stages by *P. communis, M. pensylvanica* and/or *Rhus radicans* growing through open herbaceous vegetation. At the border of upland areas with salt marsh, *I. frutescens,* with or without *Phragmites,* grew through mats of drift material. *I. frutescens* was also scattered and/or mixed with *Phragmites* throughout the upper salt marsh reaches. Evidence from study islands 85dmi and A59a indicated that the *Phragmites* may have invaded pre-existing *Iva*-high marsh mixtures.

193. On most islands, the *Phragmites*-shrub mixture covered a large area. It varied from low shrubs within a *Phragmites*-dominant stand to *Phragmites* within a taller shrub dominant stand. In time, the shrubs mixed with the *Phragmites* will probably exceed the height of the *Phragmites* and then dominate the *Phragmites*-shrub association. However, shrub domination was also observed in places where the shrub thickets had

probably become established before invasion by *Phragmites*.

194. In some areas, especially in early *Phragmites*-shrub associations, numerous shrub skeletons were found. Study islands 45A and A61c contained a larger number of these skeletons than most other islands. An explanation of this phenomenon is uncertain, but a late frost-kill in May 1977 was believed responsible. Salt water flooding during storms or from dredged material deposition on pre-existing shrub associations also produces similar effects.

195. Currently, grassland is only a minor component of mid seral stage islands studiedin this report, but the grassland communities were probably important to the earlier development of the shrub thicket communities. In dense grassland succession, the grasses and herbs common in the earlier seral stages persisted (temporarily?) in the ground layer. With increasing density of the *Phragmites* and shrub canopy, the grassland will most likely die out. The herb layer beneath the dense *Phragmites* studied was composed of only a few plants.

LATE SERAL STAGES (MAPPING UNITS: SHRUB, SHRUB-FOREST)

196. Shrub thickets were considered to be a late seral stage on the study islands. Shrubs are established on dredged material deposits either alone or mixed with *Phragmites*. Shrubs dominating the *Phragmites*-Shrub associations eventually increase in cover and density to the point of forming their own thickets, while this was recorded on islands 9-14 years old, (A61c, 98B North, 109) the age of the deposition from which the shrubs grew is unknown.

197. Most of the same species that occurred in mid seral stage uplands dominated the later seral stages (*Myrica pensylvanica, Baccharis halimifolia* and *Rhus copallina). Iva frutescens,* sometimes mixed with *B. halimifolia* and *M. pensylvanica,* formed thickets on the perimeter of the dredged material deposits.

198. The shrub-forest was the most advanced seral stage observed on the study islands and its most important tree species were *Juniperus*

virginiana and *Prunus serotina*. The trees appeared to be randomly spaced through the shrub thickets, and were also occasionally found in mid seral stage shrub-grassland communities. Shrub-forest was found on 12-14 year old islands (109, 98B South). *Rhus radicans* and *Pathenocissus quinquefolia* were also common within the shrub-forest communities.

SERAL STAGE CHRONOLOGY

199. Early seral stages were represented by vegetative communites classified as bare, sparse grassland, dense grassland and *Phragmites*. Species tolerant to saline, dry or wet soil conditions and *Phragmites* tend to be colonizing or pioneering species. Dredged material islands provide habitat to both salt marsh species and upland species.

200. Mid seral stages were typified by young *Phragmites*-shrub, and shrub-dense grassland communities which may or may not successfully invade earlier seral stage communities. Late seral stages were characterized by shrub and shrub-forest communities. They occur on the higher upland portions of older dredged material islands not subject to periodic flooding and lacking high soil salinity. Table 64 provides available data on the age, characteristic seral stage, other seral stages present, and vegetative communities present on each study island.

201. Dredged material islands utilized from 1963-1966 (11-14 years old) exhibited late seral stage vegetation. Mid seral stages were found on islands that were deposited upon from 1963-1968 (9-14 years old). Early seral stages were found on islands varying in age from 2 years to at least 12 years old. It is therefore clear that factors other than age also influence the successional stages found on these islands, and would account for the variation between age and overlapping seral stages found on each study island. Unfortunately, investigation of these factors was not a part of this study.

TABLE 64. Deposit Age and Seral Stage Relationships

ISLAND	LAST DEPOSIT[1]	DOMINANT MAPPING UNITS	CHARACTERISTIC SERAL STAGE	OTHER SERAL STAGES PRESENT
A12	pre 1969*	GS-P-PS	early	mid
A35	pre 1969*	P-GD-PS-S	early	mid; late
45A	1976	B-P-GD(S)	early	none
X27	pre 1969*	GD-S-P-PS	late	early; mid
A61c	pre 1959**	P-S-PS	early	mid; late
85dmi	1966	P-S-PS	late	early; mid
98A	1968	PS-SGD	mid	early; late
98B North	1968	P-S-PS	mid	early; late
98B South	1968	P-PS-SF	late	early; mid
103	1975	B-P	early	none
109	1965	P-S-PS-SF	mid	early; late

(continued)

1. U.S. Army Corps of Engineers, Philadelphia District.

* F. Lesser, Ocean County Mosquito Control Commission.

** Based upon bird banding data, U.S. Fish and Wildlife Service, Patuxent, Md.

P=*Phragmites;* S=Shrub; PS=*Phragmites*-Shrub; SF=Shrub-Forest; GD=Dense Grassland; GD(S)=Dense Grassland with Shrubs; B=Bare; SGD=Shrub-Dense Grassland; L=*Lonicera;* LS=*Lonicera*-Shrub; GS=Sparse Grassland.

TABLE 64 (Concluded). Deposit Age and Seral Stage Relationships

ISLAND	LAST[1] DEPOSIT	DOMINANT MAPPING UNITS	CHARACTERISTIC SERAL STAGE	OTHER SERAL STAGES PRESENT
A12 North	pre 1969*	B-P-PS	early	mid; late
A43a	pre 1969*	P-PS	early	mid
45B	1963	P-PS	early	mid; late
51B	1965	P-PS-GS-GD	early	mid
A59a	1968	P-PS-GS-SGD	mid	early; late
78B South	1969	PS-S-SF	late	early; mid
85c	1976	B-P-GD(S)	early	mid; late
85 South	1966	S-PS-SGD	late	mid
108 B	1965	P-PS	early	mid
109 South	1965?	P-PS-L-LS	early	mid; late

1. U. S. Army Corps of Engineers, Philadelphia District.

* F. Lesser, Ocean County Mosquito Control Commission

P=*Phragmites*; S=Shrub; PS=*Phragmites*-Shrub; SF=Shrub-Forest; GD- Dense Grassland; GD(S)=Dense Grassland with Shrubs; B=Bare; SGD=Shrub-Dense Grassland; L=*Lonicera*; LS=*Lonicera*-Shrub; GS=Sparse Grassland.

PART VI: CONCLUSION

202. Seral stage progression on the New Jersey dredged material study islands proceeded from vegetation communities and species typical of tidal salt marsh in New Jersey coastal areas to vegetation species typical of a New Jersey dune-woodland community found in dryer and higher areas (Robichaud and Buell 1973). The latter is represented by *Juniperus virginiana* and *Prunus serotina, Myrica pensylvanica,* and *Sassafras albidum*. all commonly found in the shrub and shrub forest associations on the older dredged material islands. *Parthenocissus quinquefolia* and *Rhus radicans*, viniferous vegetation characterizing coastal woodland, was also common. Vegetation representing seral stages between these two extremes was also found on various elevations and areas of dredged material islands studied. Species present were indicative of low tidal marsh, high tidal marsh, grassland and shrub thicket communities. With the exception of a few exotic species introduced by man in New Jersey (e.g. *Lonicera japonica*) no species were found that were unusual on the outer coastal plain salt marshes and sand dune habitats typifying southern New Jersey.

203. Dredged material islands provided a wide range of habitat and exhibited all seral stages of vegetation common to the barrier beach and salt marsh areas of the outer coastal plain of southern New Jersey. Their depositon on tidal salt marsh provided upland vegetation with habitat conditions favorable to growth where previously there had been none. In some instances (areas #61 and 77) marsh areas were increased by the sediment deposition in shallow water areas. In other areas, pre-existing salt marsh was destroyed and the upland habitat provided was then taken over by large stands of *Phragmites communis* (areas #A59a, 60, 58).

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APPENDIX A': COMMON PLANT SPECIES

This appendix contains a listing of common and scientific names of plant species frequently occurring on selected dredged material islands along the Intracoastal Waterway of New Jersey (Table A1). Plants occurring with some regularity on the deposits, as well as those occurring in quadrats, were collected, five species listed here were not collected. They were: *Rhus radicans, Xanthium strumarium, Asclepias syriaca, Acer rubrum,* and *Sassafras albidum.* Nomenclature follows that of Fernald, 1950, eighth ed. All specimens were verified (or identified) by Harry E. Ahles, herbarium curator at the University of Massachusets, Amherst, Ma., and co-author of The Manual of the Vascular Flora of the Carolinas. Immature specimens which could not definitely be identifed are followed by a question mark(?). Voucher specimens have been sent to the Waterways Experiment Station of the U. S. Army Corps of Engineers. Duplicates of some specimens may also be found in the herbarium of the University of Georgia.

A listing of plant species found in each mapping unit across all twenty-one dredged material islands studied for this report is also presented in Table A2. The status of each species, the mapping unit or units it occurred in and if it occurred in a vegetative community that it was not expected to be found in, are all indicated.

TABLE A1.

Common Plant Species Found on Dredged Material Study Islands in New Jersey

SCIENTIFIC NAME	COMMON NAME
**Acer rubrum*	Red Maple
Achillea millefolium	Yarrow
Amaranthus retroflexus	Pigweed; Green Amaranth
Ambrosia artemisiifolia	Common Ragweed
Amelanchier canadensis	Serviceberry; Shadbush
Ammophila breviligulata	American Beachgrass
Andropogon scoparius	Bluestem
Andropogon virginicus	Broomsedge
Apocynum cannabinum	Indian Hemp
Arenaria peploides	Sea Purslane; Seabeach Sandwort
**Asclepias syriaca*	Common Milkweed
Atriplex patula var. *hastata*	Orach
Baccharis halimifolia	Sea Myrtle; Groundsel Tree
Bassia hirsuta	------
Bromus tectorum	Brome Grass
Cakile endentula	Sea Rocket
Carex albolutescens	Sedge
Chenopodium album	Pigweed; Lamb's Quarters
Chenopodium ambrosioides	Mexican Tea
Cirsium arvense	Canada Thistle
Cirsium vulgare	Bull Thistle; Common Thistle
Convovulus sepium	Wild Morning Glory; Hedge Bindweed
Cyperus sp.	------
Cyperus esculentus	Yellow Nut-Grass
Cyperus odoratus ?	------

(continued)

TABLE A1. (continued)

Common Plant Species Found on Dredged Material Study Islands in New Jersey

SCIENTIFIC NAME	COMMON NAME
Digitaria sanguinalis	Crab Grass; Finger Grass
Distichlis spicata	Salt-Hay; Alkali-Grass
Eragrostis spectabilis ?	Tumble Grass; Petticoat Climber
Erigeron canadensis	Fleabane
Erigeron pusillus	Small Fleabane
Eupatorium album	White Thoroughwort
Eupatorium hyssopifolium	Thoroughwort
Festuca rubra	Red Fescue-Grass
Gnaphalium obtusifolium	Catfoot
Hemerocallis fulva	Daylily
Heterotheca subaxillaris	Camphorweed
Hibiscus palustris	Swamp Rose Mallow
Hudsonia tomentosa	Beach Heather; Poverty Grass
Iva frutescens	Marsh Elder
Juncus dudleyi	Rush
Juncus gerardi	Black Grass
Juniperus virginiana	Red Cedar
Lactuca biennis or *floridana*	Wild Lettuce
Lactuca canadensis	Wild Lettuce
Lactuca scariola	Prickly Lettuce
Lathyrus japonicus	Beach-Pea

(continued)

TABLE A1. (continued)

Common Plant Species Found on Dredged Material Study Islands in New Jersey

SCIENTIFIC NAME	COMMON NAME
Lechea maritima	Maritime Pinweed
Lepidium virginicum	Poor-Man's Pepper
Limonium nashii	Sea Lavender
Linaria canadensis	Toadflax
Lonicera japonica	Trumpet Honeysuckle
Mollugo verticillata	Carpetweed
Morus alba	White Mulberry
Myrica pensylvanica	Bayberry
Oenothera biennis	Evening-Primrose
Oenothera fruticosa	Evening-Primrose
Oenothera parviflora	Evening-Primrose
Opuntia humifusa	Prickly Pear
Panicum dichotomiflorum	Panic-Grass
Panicum lanuginosum	Panic-Grass
Panicum virgatum	Switchgrass
Parthenocissus quinquefolia	Virginia Creeper
Phragmites communis	Common Reed
Pinus nigra ?	Austrian Pine
Phytolacca americana	Pokeweed
Pluchea purpurascens	Marsh Fleabane
Poa annua	Bluegrass
Polygonella articulata	Jointweed
Polygonum aviculare	Knotweed
Polygonum hydropiper	Common Smartweed
Polygonum punctatum	Water-Smartweed

(continued)

TABLE A1. (Continued)
Common Plant Species Found on Dredged Material Study Islands in New Jersey

SCIENTIFIC NAME	COMMON NAME
Polygonum ramosissimum	Bush Knotweed
Prunus serotina	Black Cherry
Rhus copallina	Dwarf Sumac; Winged Sumac
**Rhus radicans*	Poison Ivy
Rosa virginiana	Rose
Rubus bifrons	Blackberry
Rumex acetosella	Sheep Sorrel; Common Sorrel
Rumex cruispus	Yellow Dock
Salicornia bigelovii	Dwarf Saltwort
Salicornia europaea	"Samphire"; Chicken Claws
Salicornia virginica	Perennial Saltwort
Salix alba	White Willow
Salix nigra	Black Willow
Salsola kali	Common Saltwort
Sambucus canadensis	Elderberry
**Sassafras albidum*	Sassafras
Scirpus americanus	Three-Square; Chair-Maker's Rush
Sesuvium maritimum	Sea-Purslane
Solanum americanum	Nightshade
Solanum dulcamara	Nightshade; Bittersweet
Solidago altissima	Goldenrod
Solidago sempervirens	Seaside Goldenrod
Solidago tenuifolia	Goldenrod
Spartina alterniflora	Salt Marsh Cordgrass
Spartina patens	Salt Meadow Cordgrass
Spergularia marina	Sand-Spurrey

(continued)

TABLE A1. (Concluded)

Common Plant Species Found on Dredged Material Study Islands in New Jersey

SCIENTIFIC NAME	COMMON NAME
Strophostyles helvola	Wild Bean
Suaeda linearis	Sea Blight
Teucrium canadense	American Germander; Wood Sage
Trifolium arvense	Rabbit's Foot Clover
Triplasis purpurea	Sand-Grape
Vitis aestivalis	Summer Grape
Vulpia octoflora	------
**Xanthium strumarium*	Cocklebur; Coltbur

* no specimen taken

TABLE A2.

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURENCE"
<u>HERBS</u>													
Achillea millefolium		X	*	0	0	X		0			*		
Amaranthus retroflexus										0			
Ambrosia artemisiifolia						0				0			
Ammophila breviligulata	X	0	*	X	0	0				X			
Andropogon scoparius			X		0	X		0					
Andropogon virginicus			X			0					*		
Apocynum cannabinum			0	0		0							
Arenaria peploides	0												"B"
Asclepias syriaca				0									
Atriplex patula var. *hastata*	X		*	X	X	X			*	*			
Bassia hirsuta	0		X	0		0			X				"P"
Bromus tectorum	*	*	0			0							"S"
Cakile edentula	0	0	X	X		X			X	X			
Carex albolutescens			0										
Chenopodium album	0		0			0							
Chenopodium ambrosioides	0	X	X	X	0	0				0			
Cirsium arvense			0	0	0								
Cirsium vulgare										0			
Convovulus sepium		X	X	*	X	X			X	0		X	"I"
Cyperus sp.		X	X										

(Continued)

TABLE A2. (Continued)

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURRENCE"
<u>HERBS</u>													
Cyperus esculentus	O												
Cyperus odoratus ?										O			
Digitaria sanguinalis	O					X							
Distichlis spicata	X			O	O	O		*	*	X	X		
Eragrostis spectablis ?		*	X	X	X								
Erigeron Canadensis					O								
Erigeron pusillus		*	X	X	O	O							"S"
Eupatorium album			X								O		
Eupatorium hyssopifolium			X										
Festuca rubra	O	X	X	X	X	*		X		X			
Gnaphalium obtusifolium			O	O	O			O			X		
Hemerocallis fulva		O											"SG"
Heterotheca subaxillaris										O			
Hibiscus palustris			O	X		X				O			
Hudsonia tomentosa		O											
Juncus dudleyi			O										
Juncus gerardi				O	X	X		X	O				
Lactuca biennis or *floridana*			X	X	O	O							
Lactuca canadensis			O										

(continued)

TABLE A2. (Continued)

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURRENCE"
HERBS													
Lactuca scariola						0							
Lathyrus japonicus		0	0										
Lechea maritima		X											
Lepidium virginicum	0	0	X	X	0	X		0			X		
Limonium nashii					0	X		X	X	X			
Linaria canadensis		X											
Mollugo verticillata		X											
Oenothera biennis	0		X	0	X					X			
Oenothera fruticosa		0		X	0								
Oenothera parviflora		X		0									"P"
Opuntia humifusa			0										"DG"
Panicum dichotomiflorum	0		0							X			
Panicum lanuginosum		X	X								*		
Panicum virgatum		0	X	0	0	0				X			
Phragmites communis	*	*	*	*	*	*	0	*	X	*	X	*	
Phytolacca americana			0	0	0	0				0			
Pluchea purpurascens			X	0	X	X			X				
Poa annua	0									X			
Polygonella articulata		X											

(Continued)

TABLE A2. (Continued)

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURRENCE"
<u>HERBS</u>													
Polygonum aviculare						X		X		0			
Polygonum hydropiper				0	0								
Polygonum punctatum			0	0		X				X			
Polygonum ramosissimum										0			
Rumex acetosella			0										
Rumex crispus			0	0	0					0			
Salicornia bigelovii	0								X				"B"
Salicornia europaea	0		X	X	0	X		X	*	X			"P/B"
Salicornia virginica						X			X				
Salsola kali	0		0	X		0			0	0			
Scirpus americanus			X	0	X	X		0	0	0			"I"
Sesuvium maritimum	0									0			
Solanum americanum			0	0		0				0			
Solanum dulcamara					0								
Solidago altissima			0			0					*	*	
Solidago sempervirens	0	*	*	X	*	X		X	0	*	0	*	"I"
Solidago tenuifolia		0	*	X	X	X							
Spartina alterniflora	*		*			X		X	*	X			"DG"
Spartina patens	0	X	*	X	*	X		*	*	*			

(Continued)

TABLE A2. (Continued)

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURRENCE"
HERBS													
Spergularia marina	O		X						X	X			"DG"
Strophostyles helvola	O		X	X	X	X		O		O			
Suaeda linearis	O				O	O			O	X			
Teucrium canadense			O	X	O	O		O		O		X	
Trifolium arvense					O								
Triplasis purpurea	*	*											
Vulpia octoflora		*	X	X	O								
Xanthium strumarium	O		O										"DG"
SHRUBS													
Baccharis halimifolia			X	X	*	*		*		X	*	*	
Iva frutescens	O		X	X	X	*	*	*	X	O			
Myrica pensylvanica	X	X	*	X	*	*	*	X		O		X	
Rhus copallina		X	X	O	X	X				X	*	*	
Rosa virginiana					O								
Rubus bifrons			X										
Sambucus canadensis			O	O	X	O				O		X	

(Continued)

TABLE A2. (Concluded)

Plant Species Found Within Mapping Units On All Study Islands

SPECIES	BARE	SPARSE GRASSLAND	DENSE GRASSLAND	*PHRAGMITES*	*PHRAGMITES*-SHRUB	SHRUB	SHRUB-FOREST	SHRUB-DENSE GRASSLAND	INTERTIDAL	DIKE	*LONICERA*	*LONICERA*-SHRUB	"UNUSUAL OCCURRENCE"
<u>TREES</u>													
Acer rubrum					0								"PS"
Amelanchier canadensis						0							
Juniperus virginiana			0	0	0	0	*						
Morus alba						0							"PS"
Pinus nigra?			0										"DG"
Prunus serotina		0	X			0	0			0			"SG"
Salix alba					0	0							
Salix nigra				X	X	0							
Sassafras albidum					0								"PS"
<u>WOODY VINES</u>													
Lonicera japonica			X		X	0					*	*	
Parthenocissus quinquefolia			X	0	0	X				0	*	*	
Rhus radicans		X	X	0	0	*	*			X	*	X	
Vitis aestivalis					0								"PS"

X = sampled; 0 = observed; * = major species in mapping unit.

Mapping Units: B = Bare; SG = Sparse Grassland; DG = Dense Grassland; I = Intertidal; P = *Phragmites*; S = Shrub.

APPENDIX B': SUMMARY TABLES

Table B1 provides the frequency, height and cover class equivalents that were used to classify vegetation data in this report. It is self-explanatory.

Tables B2, B3, and B4 provide average frequency, height and cover classes for all major species that were encountered within mapping units across all study islands.

Table B5 provides the total area size of all dredged material deposit areas studied and the total area size for each category of vegetative community type or mapping unit across all twenty-one dredged material islands studied. The total area size studied on all dredged material deposits occupied by each particular mapping unit is presented as a percentage of the total area size of all studied dredged material deposits.

TABLE B1. CLASS EQUIVALENTS

I. FREQUENCY CLASS EQUIVALENTS

CLASS	PRESENT IN % OF ALL MAPPING UNIT QUADRATS
1	0-25
2	26-50
3	51-75
4	76-100

II. COVER CLASS EQUIVALENTS

CLASS	% OF GROUND SURFACE COVERED
1	0-5
2	6-25
3	26-50
4	51-75
5	76-100

III. HEIGHT CLASS EQUIVALENTS

CLASS	HEIGHT IN METERS
1	0-0.10
2	0.11-0.50
3	0.51-1.0
4	1.01-2.0
5	2.01-4.0
6	4.01-10.0

TABLE B2.

Average Frequency Classes of Major Plant Species On All Study Islands

SPECIES / MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND		
	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium												
Ammophila breviligulata												
Andropogon virginicus												
Atriplex patula var. *hastata*												
Baccharis halimifolia												
Bromus tectorum	2									2		
Cakile edentula												
Chenopodium album												
Convolvulus sepium												
dead shrubs												
Distichlis spicata												
Eragrostis spectabilis										2		
Erigeron pusilus										3		
Festuca rubra												
Iva frutescens												
Juniperus virginiana												
Lepidium virginicum												
Lonicera japonica												

SPECIES / MAPPING UNIT	DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			*PHRAGMITES*		
	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium				2								
Ammophila breviligulata				3								
Andropogon virginicus												
Atriplex patula var. *hastata*	2											
Baccharis halimifolia												
Bromus tectorum												
Cakile edentula												
Chenopodium album												
Convolvulus sepium										2		
dead shrubs												
Distichlis spicata												
Eragrostis spectabilis												
Erigeron pusilus												
Festuca rubra												
Iva frutescens												
Juniperus virginiana												
Lepidium virginicum												
Lonicera japonica												

SPECIES / MAPPING UNIT	*PHRAGMITES*-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND		
	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium												
Ammophila breviligulata												
Andropogon virginicus												
Atriplex patula var. *hastata*												
Baccharis halimifolia	2	3		2	2					2	2	
Bromus tectorum												
Cakile edentula												
Chenopodium album												
Convolvulus sepium												
dead shrubs												
Distichlis spicata										2		
Eragrostis spectabilis												
Erigeron pusilus												
Festuca rubra				2								
Iva frutescens				2	2			3		2	3	
Juniperus virginiana								3				
Lepidium virginicum												
Lonicera japonica												

SPECIES / MAPPING UNIT	INTERTIDAL			DIKE			*LONICERA*			*LONICERA*-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium							4					
Ammophila breviligulata												
Andropogon virginicus							2					
Atriplex patula var. *hastata*	1			1								
Baccharis halimifolia							2	2		2	3	
Bromus tectorum												
Cakile edentula												
Chenopodium album												
Convolvulus sepium												
dead shrubs							3	3		3	4	
Distichlis spicata	1											
Eragrostis spectabilis												
Erigeron pusilus												
Festuca rubra												
Iva frutescens												
Juniperus virginiana												
Lepidium virginicum												
Lonicera japonica							4	3		4	4	

(Continued)

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

TABLE B2. (Concluded)

Average Frequency Classes of Major Plant Species On All Study Islands

SPECIES / MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND			DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			*PHRAGMITES*			*PHRAGMITES*-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND			INTERTIDAL			DIKE			*LONICERA*			*LONICERA*-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Myrica pensylvanica														2											2	3		2	3			4																
Panicum lanuginosum																																											2					
Pathenocissus quinquefolia																																												2		3	3	
Phragmites communis				2						1	1		3	3		2	2					4	4		4	4		2	2					2	2					4						2	4	
Rhus copallina																																												2		2	3	
Rhus radicans																												1	2			4											3	3				
Salicornia europaea																																					1											
shrub seedlings																									2																							
Solidago altissima																																											3			3		
Solidago sempervirens										2			2			2			2						2									2						1						3		
Solidago tenuifolia													2																																			
Spartina alterniflora							4			2																											3											
Spartina patens													2						4						2									4			3			1								
Triplasis purpurea	2									1																																						
Vulpia octoflora										1																																						

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

TABLE B3.

Average Cover Classes of Major Plant Species On All Study Islands

SPECIES / MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND			DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			PHRAGMITES		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium																2								
Ammophila breviligulata																3		2						
Andropogon virginicus																								
Atriplex patula var. *hastata*													2											
Baccharis halimifolia																								
Bromus tectorum	1									2														
Cakile edentula									2															
Chenopodium album									2															
Convolvulus sepium																						2		2
dead shrub																								
Distichlis spicata																								
Eragrostis spectabilis										2														
Erigeron pusillus										2														
Festuca rubra																								
Iva frutescens																								
Juniperus virginiana																								
Lepidium virginicum									2															
Lonicera japonica																								

SPECIES / MAPPING UNIT	PHRAGMITES-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND			INTERTIDAL			DIKE			LONICERA			LONICERA-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium																			2					
Ammophila breviligulata																								
Andropogon virginicus																			1					
Atriplex patula var. *hastata*													2			2								
Baccharis halimifolia	3	3	2	3	3	3				2	2								2	2		2	4	
Bromus tectorum																								
Cakile edentula																								
Chenopodium album																								
Convolvulus sepium																								
dead shrub																			2	2		2	2	
Distichlis spicata							3						3											
Eragrostis spectabilis																								
Erigeron pusillus																								
Festuca rubra				4		3																		
Iva frutescens				3	3	4		2		3	2													
Juniperus virginiana								1	2															
Lepidium virginicum																								
Lonicera japonica																			4	5		5	5	

(Continued)

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

TABLE B3. (Concluded)

Average Cover Classes of Major Plant Species On All Study Islands

SPECIES / MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND			DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			PHRAGMITES		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Myrica pensylvanica														2										
Panicum lanuginosum																								
Parthenocissus quinquefolia																								
Phragmites communis				3		1				1	2		2	2		4	2	2				3	3	5
Rhus copallina																								
Rhus radicans																								
Salicornia europaea																								
shrub seedlings																								
Solidago altissima																								
Solidago sempervirens										2			2			2		2	2					
Solidago tenuifolia													3											
Spartina alterniflora							3						2											
Spartina patens													3						4					
Triplasis purpurea	1									1														
Vulpia octoflora										1														

SPECIES / MAPPING UNIT	PHRAGMITES-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND			INTERTIDAL			DIKE			LONICERA			LONICERA-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Myrica pensylvanica	3	2	2	4	3	3		3																
Panicum lanuginosum																			1					
Parthenocissus quinquefolia																				3		3	2	
Phragmites communis	3	4	4	2	2	2				2	2					2		3				1	1	
Rhus copallina																				2		4	3	
Rhus radicans				3	3	3		4											2	2				
Salicornia europaea													1		2									
shrub seedlings	2		2																					
Solidago altissima																			1			2		
Solidago sempervirens	2		2							2						3						2		
Solidago tenuifolia																								
Spartina alterniflora													3		3									
Spartina patens	3		3							4			4		4	3								
Triplasis purpurea																								
Vulpia octoflora																								

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

TABLE B4.

Average Height Classes of Major Plant Species On All Study Islands

SPECIES / MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND			DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			*PHRAGMITES*			*PHRAGMITES*-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND			INTERTIDAL			DIKE			*LONICERA*			*LONICERA*-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Achillea millefolium																2																											2					
Ammophila breviligulata																3		2																														
Andropogon virginicus																																											2					
Atriplex patula var. *hastata*													2																								2			2								
Baccharis halimifolia																									4	4	4	5	5	5				3	2								4	5		5	4	
Bromus tectorum	2									2																																						
Cakile edentula									2																																							
Chenopodium album									2																																							
Convolvulus sepium																						2		2																								
dead shrub																																											4	4		5	5	
Distichlis spicata																																		2			2											
Eragrostis spectabilis										2																																						
Erigeron pusillus										1																																						
Festuca rubra																												2		2																		
Iva frutescens																												3	4	4		4		3	3													
Juniperus virginiana																																6	6															
Lepidium virginicum									2																																							
Lonicera japonica																																											2	3		3	3	

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

(Continued)

TABLE B4. (Concluded)

Average Height Classes of Major Plant Species On All Study Islands

SPECIES \ MAPPING UNIT	BARE (UPLAND)			BARE (DIKE)			BARE (BEACH)			SPARSE GRASSLAND			DENSE GRASSLAND (DRIFT)			GRASSLAND (UPLAND)			DENSE GRASSLAND (INTERIOR HIGH MARSH)			*PHRAGMITES*		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Myrica pensylvanica														4										
Panicum lanuginosum																								
Parthenocissus quinquefolia																								
Phragmites communis				3		3				3	3		3	3		3	4	3				4	4	5
Rhus copallina																								
Rhus radicans																								
Salicornia europaea																								
shrub seedlings																								
Solidago altissima																								
Solidago sempervirens										2			2			2		3	2					
Solidago tenuifolia													2											
Spartina alterniflora							3						2											
Spartina patens													2						2					
Triplasis purpurea	1									1														
Vulpia octoflora										1														

SPECIES \ MAPPING UNIT	*PHRAGMITES*-SHRUB			SHRUB			SHRUB-FOREST			SHRUB-DENSE GRASSLAND			INTERTIDAL			DIKE			*LONICERA*			*LONICERA*-SHRUB		
	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V
Myrica pensylvanica	5	4	5	4	5	5		5																
Panicum lanuginosum																			2					
Parthenocissus quinquefolia																				3		3	3	
Phragmites communis	4	5	4	4	4	3				4	4					3		4				4	4	
Rhus copallina																				3		4	4	
Rhus radicans				3	4	4		5											2	3				
Salicornia europaea													2		2									
shrub seedlings	2		2																					
Solidago altissima																			2			3		
Solidago sempervirens	2		2							2						2						2		
Solidago tenuifolia																								
Spartina alterniflora													2		2									
Spartina patens	2		2							2			2		3	2								
Triplasis purpurea																								
Vulpia octoflora																								

H=Herb Quadrat; S=Shrub Quadrat; V=Visual Estimate

TABLE B5.

Size of All Dredged Material Deposits and Mapping Units Studied in New Jersey

TOTAL AREA OF DREDGED MATERIAL DEPOSITS STUDIED: 87.16 Acres 35.26 Hectares

MAPPING UNIT TYPE	ACRES	HECTARES	% OF ALL DEPOSITS
Bare	7.90	3.19	9.1
Sparse Grassland	4.35	1.76	5.0
Dense Grassland	3.58	1.45	4.1
Phragmites	34.12	13.81	39.1
Phragmites-Shrub	14.91	6.03	17.1
Shrub	11.93	4.83	13.7
Shrub Forest	0.50	0.23	0.6
Shrub-Dense Grassland	5.36	2.15	6.1
Dike	2.84	1.16	3.3
Water	0.35	0.14	0.4
Intertidal (within deposit)	0.67	0.27	0.8
House	0.02	< 0.01	0.02
Lonicera	0.47	0.19	0.5
Lonicera-Shrub	0.16	0.07	0.2
	87.16	35.26	100.0%
Drift (on deposit)	3.23	1.31	3.7
Non-Drift (on deposit)	83.93	33.95	96.3
	87.16	35.26	100.0%

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Use of dredged material islands by colonial seabirds and wading birds in New Jersey; Appendix B: Vegetation analysis / by Francine G. Buckley, Cheryl A. McCaffrey, Manomet Bird Observatory, Manomet, Mass. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

204, 12, 9 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-1, Appendix B)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW 39-76-C-0166 (DMRP Work Unit No. 4F01D)

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1. Birds. 2. Dredged material. 3. Islands (Landforms). 4. New Jersey. 5. Seabirds. 6. Shore birds. 7. Succession. 8. Vegetation. I. McCaffrey, Cheryl A., joint author. II. Manomet Bird Observatory. III. United States. Army. Corps of Engineers. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-1, Appendix B.

TA7.W34 no.D-78-1 Appendix B

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